VOL. IX. No. 2. MARCH, 1902

THE PSYCHOLOGICAL REVIEW.

RECENT LOGICAL INQUIRIES AND THEIR PSYCHOLOGICAL BEARINGS.[1]

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The American Psychological Association has always given a kindly recognition to the general philosophical interests which many of its members represent, as well as to the more distinctively psychological concerns which properly form the center and the main body of its undertakings. In honoring me, by calling me to fill for the year the office of president, my fellow members have well known that they ran the risk of hearing a discussion rather of some philosophical problem than of a distinctively experimental topic. I, in my turn, am quite unwilling to ignore or to neglect the fact that ours is primarily a psychological association, while I am equally aware that the general student of philosophy is at a disadvantage when he tries to discuss with the productive workers in the laboratories the matters which, as their specialty grows, come to be increasingly their own peculiar possession. Yet a presidential address is properly an opportunity for studying the problems suggested by a comparison of various fields and methods of work. And accordingly, upon this occasion, I propose to discuss some questions that lie on the borderland between psychology and the distinctively philosophical disciplines. These questions in part directly touch undertakings which already occupy a recognized place in the psychological laboratories. In part they seem to me to

[1] Address of the president before the American Psychological Association, Chicago meeting, January, 1902.

promise to yield in future still wider opportunities for experimental research than are now open. In any case they are questions of permanent interest, and of increasing importance, which neither the psychologist nor the philosopher can afford to ignore.

I.

I have named my paper a discourse upon 'recent logical inquiries and their psychological bearings.' By the term 'recent logical inquiries,' I mean to refer to two decidedly distinct classes of researches, both of which are to-day receiving much attention. To the first of these two classes belong researches directly bearing upon the psychology of the thinking process, and upon the natural history of logical phenomena in general. Such inquiries may be called logical, since they are sometimes undertaken by logicians for the sake of their own science, and in any case are suggested by the problems of logic. Meanwhile, studies of this class are obviously also, at least in intention, contributions to psychology. But I wish, in addition, before I am done, to call attention to quite another class of researches, whose psychological bearing is not at first sight so evident. This my second class of recent logical inquiries consists of studies in the comparative logic of the various sciences, and of examinations of the first principles of certain special sciences. I refer here especially to such books as Mach's well-known volume on the 'Principles of Mechanics,' and to all the large literature that has grown up about the problems suggested by the fundamental concepts of the different natural sciences. I place in the same class, moreover, the elaborate and fruitful researches into the foundations of arithmetic, of geometry, and of the Theory of Functions, which are due to such mathematicians as Cantor, Dedekind, Peano, Klein, Hilbert. The last three or four decades have seen an enormous extension of the literature of this type. I include, moreover, in the same class, certain more distinctively philosophical treatises such as Russell's 'Essay on the Foundations of Geometry,' and Couturat's volume on the 'Concept of the Infinite,' and these are but specimens of the class of inquiries in question.

I mention this vast collection of significant studies, not be-

cause I am in any sense a master in this field of the comparative logic of the sciences, but because, as a humble learner, I have been trying to make my way in some of the plainer of the paths that these recent studies have been opening, and because I hope, by a few wholly inadequate, but at least timely indications, to show upon this occasion that this relatively new comparative study of the fundamental conceptions of various sciences, is full of promise for the psychologist as well as for the logician.

Of the intrinsic importance of this my second class of 'logical inquiries,' there can be, in many cases, no doubt. From the literature of comparative logic to which I thus refer, there is certain to grow, with time, a new science, which I may venture to call a comparative morphology of concepts. This science will occupy a borderland position. In one respect, it will belong to philosophy properly so called. For it will lead to advances in just that critical consideration of the foundations of knowledge which constitutes one principal division of philosophy. Upon the other hand, the new science will be an empirical as well as a reflective doctrine. It will include a critical examination of the history and evolution of the special sciences. And in this respect it will take its place as a contribution to the general history of culture, and will furnish material for the student of anthropology and of social psychology. And, still further, the new science will contribute to the interests of the student both of general and of experimental psychology. For it will set in a new light the empirical problems of the psychology of the intellect. It will define, in new form, issues which the descriptive psychologist must attempt to reconsider. And, as I am convinced, it will present an ample array of problems for the experimental psychologist,—problems which he alone will be able to pursue into some of their deepest recesses. This new science, then, which you and I can hardly live to see very highly organized, but which the whole century now beginning will greatly advance, will offer large ranges of what one may call neutral ground, where philosopher and psychologist, special student and general inquirer, historian and sociologist, may seek each his own, while a certain truce of God may reign there re-

garding those boundary feuds which these various types of students are prone to keep alive, whenever they discuss with one another the limits of their various territories, and the relative importance of their different tasks.

II.

Two distinct and very large classes of 'logical inquiries' my title is thus intended to bring at once to your attention. My reason for naming them by means of one phrase, and for considering them in one paper, is this: When you examine the first of my two classes of recent inquiries, you find that while much is now doing to advance our knowledge of the psychology of the thinking process, we have to admit that the present state of research in this field is not wholly satisfactory. The general theories about what the place of thought is in the natural history of our minds, and about the special processes of which thinking consists, are numerous; but regarded as psychological theories, they still seem for the most part loose and ill-founded. On the other hand, the special efforts to break paths into the thickets of the psychology of the thinking process by means of experimental research, have so far met with serious obstacles, have often given negative results, and in any case have been confined to the outskirts of the subject. A survey of our first class of recent inquiries will therefore suggest to us the need of looking in new directions for additional sources of aid in the study of the psychology of the higher intellectual processes. In view of this fact it may appear, before we are done, that there is a genuine promise of help towards further advances in this branch of psychology, in case we look for such help to what I have called my second class of recent inquiries in logic. These studies in the comparative logic of the sciences are at once, as I have said, philosophical and empirical studies. They are logical researches regarding the foundations of knowledge. They are also historical reports regarding the way in which our human thinking processes have worked and are working in the world of live thinkers and of socially guided investigations. To call attention, in however feeble or summary a way, to the evidence that is thus attainable regarding the natural history of the think-

ing process, is a purpose that may justify my necessarily very superficial comments upon this branch of my topic.

III.

And so let me next say something about the first of my two classes of recent inquiries, namely, those that are more obviously and explicitly guided by psychological motives.

The psychology of the intellect is one of the oldest branches of psychological inquiry. In Greece it began in pre-Socratic philosophy. It became prominent in Aristotle's doctrine. Both Stoics and Epicureans contributed to it. Scholasticism elaborated and modified Aristotle's theories regarding the whole province. Modern philosophy, and in particular the English psychology, began with renewed interest in the problems of this branch of mind. Thus, the psychology of knowledge was long the favored child of the philosophers, at times when the feelings and the more purely volitional aspects of mental life were comparatively neglected in their researches. In a sense this advantage of the intellectual process has continued in recent times. The psychology of association and that of perception have been steadily advancing. Attention, discrimination, and lately memory, have been experimentally studied. But on the other hand, in recent psychology, just the region where, at the outset, the interest of the philosophers was early centered, namely, the region of study of the higher intellectual processes—conception, judgment and reasoning—is the very province of psychology where progress, in any exact sense, is nowadays so slow. The difficulty of reducing the problems which, for the psychologist, arise in this region, to any form capable of exact experimental inquiry, is notoriously great, and will of course long remain so. Meanwhile, however, the actual importance which psychological methods have won in the esteem of modern writers, have led to repeated attempts to found reforms in logic upon psychological theories. Numerous are the modern works on logic wherein the psychology of the thinking process is expounded at the beginning of the whole research, or at least is made the basis upon which an author's logical doctrines depend. The great influence of Brentano's doctrine of the process of

judgment upon one whole series of logical inquiries in Germany is well known, and is an example of what I mean. The earnestness with which the problem of the nature of the 'impersonal' judgments has been discussed by a large number of modern writers on logic is another example of this subordination of logical to psychological issues. For the doctrine of the 'impersonal' forms of expression is a problem of the psychology of language, and to my mind, interests the pure logician hardly at all.

Meanwhile, if psychological doctrines have thus played a large part in the books upon logic, one can hardly feel surprised to find that, in the present state of the psychology of the intellect, the theories about the higher intellectual processes which have been expounded in the logical treatises have been somewhat dishearteningly various and capricious. Concerning the processes of abstraction and conception, certain stereotyped formulas were indeed, until quite recently, pretty constantly repeated. But with the doctrine of judgment, chaos in the textbooks of logic began. Judgment was, so one sometimes said, a process of pure association of ideas, wherein the subject idea recalled to mind by contiguity the predicate idea. But no, said others, it was rather a process of Herbartian apperception, wherein the predicate idea assimilated the subject idea and forced it to fuse with itself so that they became but one idea. On the other hand it was often something much nobler; it was an active process of synthesis, not to be confounded either with mere association or with passive fusion—a constructive process wherein subject and predicate idea came to be connected by certain peculiar mental links. Yet not so; on the contrary, it was a process of analysis, whereby a given whole was divided into parts, and the subject and predicate were the products of this sundering. Or, yet again, it was no union and no sundering of ideas at all, but something quite different—an estimate about the objective value of a connection of ideas. But still once more, it was none of all these things, it was an entirely irreducible act of accepting or rejecting an idea or a complex of ideas; and upon this psychologically irreducible and primal act was founded our very conception of any distinction whatever

between the objective and the subjective world. All these things judgment has been in the text-books, and this, as you well know, is not the end. And all these views have been advanced, upon occasion, as psychological theories about the process of judgment, as theories either verifiable by direct introspection or else deducible from more general doctrines about our mental processes.

In presence of such a variety of opinions, many students interested in the theory of the thinking process have tended, in more recent discussion, to choose one of two opposed directions. Either they have been disposed to relieve themselves altogether of any responsibility for settling the psychological problems, by drawing a technically sharp line between Logic and Psychology, by devoting themselves to the former, and by leaving out of the logical inquiry all consideration whatever of the descriptive psychology of thinking; or else, choosing rather the psychological road, they have attempted to reduce the problems in question to some shape such as would make possible a more exact introspection of the details of the thinking process by causing these to occur under experimental conditions. The former of these two ways of dealing with the problem of the nature of the thinking process has recently been formally adopted, amongst other writers, by Husserl, in his *Logische Untersuchungen*. Husserl has vigorously protested against all *psychologisirende Logik*. Logic, he insists, must go its own way, yet Husserl, in his still unfinished and very attractive researches, yet lingers over the problems of what he now calls the 'phenomenological analysis' of the thinking process, and his farewell, as a logician, to psychology proves to be a very long one, wherein the parting is such sweet sorrow that the logician's escape from the presence of psychology is sure to lead to further psychological complications. As a fact, I cordially accept, for myself, the view that the central problems of the logician and of the psychologist are quite distinct, and that the logician is not responsible for, or logically dependent upon a psychological theory of the thinking process. Yet I am unable to doubt that every advance upon one of these two sides of the study of the intellectual life makes possible, under the conditions to which all our

human progress is naturally subject, a new advance upon the other side. I believe in not confounding the tasks of these two types of inquiry. But I do believe that a mutual understanding between the workers will be of great importance; and I feel that we need not discuss at very great length, or insist with exaggerated strenuousness upon the mere separation of provinces in a world of inquiry wherein to-day there are rather too many sunderings.

Meanwhile, as to the other way of approaching the problem of the nature of the thinking processes, namely the way of attacking them from the side of a more careful application of the methods of recent psychology, that at present, as I have said, is beset with well-known difficulties—difficulties upon which I need not dwell long in this presence. The most important thinking processes do not occur under conditions such as either the subject in the laboratory can easily reinstate at will, or the experimenter can determine for the subject while the latter is under observation. The thinking processes upon which experimenters have so far carefully worked are therefore artificially simplified ones—important, but elementary. The numerous investigations regarding the process of the perception of small differences of various types belong here, and constitute, in one aspect, a contribution to the psychology of judgment. The mental reactions upon the presentation of words and phrases, heard or seen by the subject, have been studied by Ribot and by others. Recently Marbe has undertaken to investigate experimentally the psychology of judgment, although under conditions that I have to think by no means very satisfactory. Simple computations, acts of recognition, of estimate, of naming, have also been investigated in various laboratories. But as you know, the positive and assured results of such work have been by no means all that one could wish. Especially notable has been the decidedly negative result of a good deal of this investigation of artificially simplified thinking processes. While, to be sure, the study of the perception of small differences has shown how unexpectedly complex are the psychophysical conditions upon which such judgments depend, the effort in case of even much more complex and intelligent thinking processes to

find present in consciousness contents as complex as those of a rational thinker ought to be, has not met, under experimental conditions, with the success that one might have hoped for.

Ribot discovered that in many cases, when one presented to the thoughtful subject a general term whose meaning was somewhat abstract, but nevertheless familiar to him, and when one asked him what mental contents the suddenly presented term directly brought to mind, the answer was simply, 'nothing.' Marbe, dealing with trained subjects, of scientific habits of mind, made them perform and express simple acts of judgment, under experimental conditions, and asked them to observe introspectively the conscious accompaniments of these acts. He found, in general, that the subjective accompaniment of the judgment, apart from the direct consciousness of the very act whereby one gave expression to the judgment, was nothing at all characteristic, and was very often, as in Ribot's subjects, simply nothing at all. The subject in Marbe's experiments was to make a judgment of some intellectual value, but pretty easily accessible to him, regarding a certain presented content; as, for example, he was to choose which one of the two perceived objects had a given character; or he was to answer some other simple question, regarding facts or ideas presented to his attention by the experimenter. He was at once to express this judgment, by word, or by other motor process, as the case might be. He was then to report what mental accompaniments the act of judging had involved at the critical moment. The result of the experiments was to show that these well-trained thinkers responded to the situation in question in a mainly reflex fashion. They expressed their discriminations, their translations of Latin phrases, or their other simple intellectual processes, with relatively little difficulty; and all that was characteristic of the conscious process at the moment was that they observed, of course, the expressive act itself, which they chose in a conscious sense no more and no less than one chooses any other complicated reflex act of high grade such as comes to consciousness while it is carried out. For the rest, they sometimes observed fleeting states such as doubt or surprise, and various chance associated images, or suggested motor

sensations, of no importance for the understanding of what it is to judge. These accompaniments of the act of judgment were merely individual accidents.

Such negative results have appeared, upon second thought, not very surprising either to Ribot or to Marbe. Ribot points out that most of the connected and significant processes of our life have to be largely unconscious, just because we are conscious only from instant to instant, while we live with reference to relatively far-off results, and while the rational connections of life have to do with long periods of time. The organization of our intelligent conduct is necessarily, he thinks, a matter of habit, not of instantaneous insight. And a complex abstract idea, as Ribot points out, is a 'habit in the intellectual order.' "We learn to understand a concept as we learn to walk, dance, fence, or play a musical instrument. * * * General terms cover an organized latent knowledge which is the hidden capital without which we should be in a state of bankruptcy." Marbe comforts himself for his negative results with the reflection that a '*Wissen*' can never be, as a content, itself '*im Bewusstsein*.' The subject judging knows, as Marbe maintains, what the act means, but no conscious content directly corresponds to or embodies this knowledge. The only necessary conscious content that is present to the subject corresponds to the outward act, the speech or gesture, whereby the subject expresses his meaning, and this, in Marbe's opinion, sufficiently explains the negative result of his own experiments.

No doubt these comments of Marbe and of Ribot have a good deal of justification so far as concerns their own experiments. On the other hand, however, we cannot feel that their experiments were at all well adapted for observing the wealth of our actual thinking processes, because what they studied was not, in most cases, any process by which a thought can come to be built up in our consciousness at all. They could not thus hope to decide how far thought ever can find a peculiar or characteristic place in human consciousness. For what they both examined were relatively reflex processes that express the mere residuum of a mental skill long since acquired by their subjects. Ribot himself thought, and no doubt consciously

thought, when he *planned* his experiments; Marbe thought, when he considered what problem to choose for presentation to his subjects. But the subject (already, in the mentioned cases, a person of relatively high training), had little or no need to think at all in a situation as simple or as familiar in its type as the one in which the experiment placed him. Therefore it was the experimenter and not the subject in whom the process that was to be studied went on. The subject already long since knew how to meet the familiar abstract term, or to translate the simple phrase, or to answer the other plain question. Either this his previous training disposed him to wait passively, upon hearing the well-known word, until he should have some reason to use it himself, or to bring it into connection with his own acts; or else just such training had prepared him (in Marbe's experiments) to accomplish the act whereby one could express a judgment upon the simple problem presented, or could otherwise easily and instantaneously show one's accustomed skill. In no such case was it necessary that any notable intellectual contents of higher grade should come to the subject's consciousness. The mechanism established by long training was ready. It responded as the training determined. Consciousness showed indeed nothing of an abstract thinking process; but then there was no live thought present to show. Ask me "What is the sum of 3 and 2?" or "Who was Washington?" and very probably I shall just then not think at all. If I am disposed, under experimental conditions, to respond to your question, without knowing beforehand what the question is to be, I shall, upon hearing such an inquiry, respond as smoothly as if I were a wholly reflex mechanism. And very naturally I shall then have nothing to report in the way of introspective facts of a thoughtful sort. For I shall respond much as a baggage clerk at a large station calls out the names of cheques, or as a telegraph operator writes out his messages while listening to the familiar clicks of the instrument.

To say this is not to make light of experimental methods in their application to the psychology of thought, but is to show that if the problems of the psychology of the intellect are to be prepared for more effective and advanced experimental research

in future, the thinking process must first, in some measure, be more fruitfully analyzed than has yet been the case, into elementary processes of a type capable of separate experimental study. On the other hand, the way in which these processes are synthesized into the richer life of concrete thinking must be discovered mainly in an indirect fashion, through an examination of the expressions of thought in the various products of the human intellect, as they appear in language, in social institutions, in the mechanical inventions and constructions which human reason has made, and in the constitution of the sciences themselves—those highest expressions of man's ingenuity. Meanwhile, as I think, a preliminary examination of these very larger expressions of the intellect themselves, may also help us to proceed further than we have yet done in the preparatory analysis of the elementary activities upon which our thought depends, and may enable us thus to open the way towards such an experimental investigation of the conscious aspects of live thinking as just now we lack.

What then is the best means to make such a preliminary analysis of the thinking process into its elements? To analyze thought by means of a study of the phenomena of language has so far been, from Plato's time onwards, the principal undertaking of those who have approached the psychological problems of the intellect from the objective side, that is, from the side of the way in which human thought has outwardly expressed itself. The logicians and the psychologists have joined in a frequent examination of the phenomena of speech. Both types of investigators have sought thus to acquire a knowledge of what the thinking process essentially is. And this sort of inquiry still prospers. A recent logician, Benno Erdmann, has undertaken elaborate studies in this field, studies that have combined the analysis of pathological facts with those experimental researches which he and Professor Dodge have made so well known. From the psychological side, and with vast resources in the way of varied materials, Wundt has also lately prepared his really wonderful volumes on language, working with all the equipment of the experimenter, the logician, and the philosopher, but carefully distinguishing the task of this recent book from that of his own

earlier treatise on logic. One may say, then, that the psychology of language is indeed in a progressive state. Yet I cannot but hold that the relation of language to the thinking process has been somewhat too exclusively emphasized by many students of the subject. Thought has other modes of expression than through the forms of speech. Language has other business besides the expression of thought. Wundt's book has the merit of emphasizing the close and primary relation of language to the expression of the feelings and to the life of the will. In consequence, Wundt very decidedly sets limits to the tendency either to regard the grammatical categories as essentially logical ones, or to use the psychology of language too exclusively as a means for interpreting the psychology of the thinking process. For this very reason his book rather encourages one to look elsewhere for auxiliaries in comprehending the psychology of the intellectual life.

I have thus endeavored to sketch some of the more directly psychological of the recent inquiries into the nature of the thinking process, in order to show why, despite all these various developments, I myself think that the psychologist still has much to learn from researches in other fields than those in which he has so far been most accustomed to seek for help. These other fields are the very ones which are opened by those recent inquiries in the comparative logic of the sciences of which I spoke at the outset.

IV.

Some widespread influence, it is hard to tell exactly what, has led, during the last three or four decades, to repeated, and often seemingly independent and spontaneous, efforts on the part of the students of various special sciences to undertake an examination into the first principles of their own branches of inquiry. The mathematicians say that it was the discovery of errors in certain accepted theorems or proofs of theorems which was the principal motive leading to their own modern desire for an increased rigidity of methods, and an increased clearness regarding their fundamental assumptions. A wide extension of some of their earlier conceptions, such as the conception of a function, resulted, during the nineteenth century, from the nat-

ural advances of their science. It was found that as such conceptions extended their range of application, theorems to which no exceptions had been known at earlier stages of the science became obviously of restricted application in the new fields thus opened, and often had to be restated altogether. In consequence, proofs of these theorems which had been accepted as valid in earlier stages of the science, were seen, in the light of the enlarged conceptions, to be invalid, or to be capable of rigid statement only through the addition of precise qualifications which had earlier escaped notice. Thus there arose a keenly critical consciousness about what constituted exact statement and rigid proof. Moreover, mathematicians are especially disposed by the work of their science to compare together the results of various and apparently independent sorts of inquiry. Especially is this the case when one considers the relations of geometrical and analytical science. At one time geometrical intuition, at another time analytical computation, may lead in the advancement of mathematical knowledge. The question therefore constantly arises, Which of these two sorts of inquiry is the superior in power, or in logical exactness? Such comparisons must lead to constantly renewed self-criticism passed by the science upon itself.

Again, early in the nineteenth century, the constructive imagination of certain geometers of genius initiated an examination of the foundations of Euclidean geometry which has since proved of the utmost importance as a study in the fundamental concepts of all science. Such influences long worked in a comparatively isolated way. Towards the close of the century they combined to bring about a sort of common consciousness on the part of mathematicians regarding the methods that they required of the investigator and of the expounder of mathematical truth. This common consciousness expressed itself not only in the regions where the science was advancing to conquer new territory, but in the study of the oldest, the most fundamental, simple and universally human of mathematical ideas. The concept of number is one of the earliest of human scientific acquisitions; yet it has recently been subjected to a searching logical analysis with decidedly novel and unexpected

results, so that nobody can rightly judge what it is to count or to use numbers for purposes of recording measurements, unless he has taken into consideration mathematical discussions that are hardly thirty years old. The various extensions of the number-concept,—the relation between rational and irrational numbers, the relations of number to quantity, the different systems of complex numbers, the conditions logically necessary in order that number systems should be applied to the expression of space-relations,—all these topics have been reviewed from the foundation upwards; and the work still goes on. The various actual or possible conceptions of continuity, the exact meaning to be ascribed to the concepts of numerical and of quantitative infinity, the logical position of the conception of an infinitesimal,—all these matters have been reconsidered with a care and a novelty of result which no one can appreciate who has not come into closer contact with at least a few of these researches. And now what I wish especially to emphasize, is that all these analyses, while their direct purpose is logical, inevitably possess a psychological bearing. For they throw light upon the structure which the universally human processes of counting, measuring, comparing and otherwise dealing with continuous magnitudes have always possessed. They define certain of our most fundamental intellectual interests in our world of experience. They therefore not only logically clarify and in so far transform these interests, but they tend to several otherwise hidden aspects of the natural history of these interests themselves.

For instance, the logical prominence which these modern researches in the logic of arithmetic give to our general concepts of serial order, as contrasted with our more specialized quantitative concepts, involve a generalization about the nature of the thinking process that at once has a psychological application. For we learn hereby to distinguish the activities through which we have formed the conception of any ordered series of facts from the processes whereby we have learned to apply this conception in certain important, but decidedly special, cases to the task of measuring magnitudes. The two processes are different, not only logically, but psychologically. The

second is a highly specialized application of the other, which is the more primitive and the simpler. The new problem that arises for the psychologist is that of the psychology of our ideas of serial order. The forms in which this problem is to be attacked with fruitful success by the psychologist must be furnished to him by the logician of mathematics. The latter discovers by analysis what concepts of order are fundamental and what ones, logically speaking, are derived; and how the more complex forms of order are related to the simpler. The solution of this logical question is of course primarily not any decision of a question of genesis. But it is the answer to the question, What forms of order, what types of serial arrangement are of the most importance in human thinking about the world of experience? This answer inevitably tells us, however, something about what is universal in the actual constitution of those habits of our organism upon which our thoughts about order depend. It is true then that to ask, What is logically fundamental in our ideas of order? is to ask not a psychological, but a logical, question. But to discover what is logically universal, as the basis of our exact ideas, is to find out a process that must be very widely represented in those organized modes of action of which our thoughts are an inner expression. Hence the result of the logician's analysis, while it cannot be directly translated into a logical theory, is inevitably the setting of a definite problem for the experimental psychologist.

As a fact, the problems of the psychology of the concept of order form a field for experimental research whose importance the whole modern logic of mathematics makes daily more obvious, while the adaptability of the problems for the labors of the experimenter is so obvious as hardly to need lengthy illustration. Psychologically speaking, the importance of the order in which facts are presented to us is illustrated by every case of an inverted letter, by every disarrangement of a familiar temporal or spatial sequence, by every instance of the illegibility even of our own handwriting when seen in a mirror. One of our earliest and principal mental interests is in the serial order of things and in the weaving of various serial orders into systems. But mathematical science is in large part an analysis

of ordinal systems. Hence an advance in our analysis of the logical concept of order, and in our knowledge of its range of application, makes possible a more fruitful study of the natural history of thought than would otherwise lie within our power.

In the modern study of the logic of the space-concept, there is again a rich field where the results of the mathematical logicians suggest problems for the psychologist. I have myself been surprised to see how little interest psychologists have generally taken in the space-theories of modern mathematics. There is a remark of Klein, repeated since by a good many writers, to the effect that modern projective geometry, with its non-metrical methods, is rather a description of the properties that are most prominent in visual space, while ordinary geometry, with its quantitative or metrical concepts, is rather founded upon our experience of the space of our touch and of our bodily movements. This remark emphasizes what is indeed an obvious fact. One may pass lightly over it, and think little of it. But its significance begins to dawn when one learns something of those logical relations between non-metrical and metrical geometry which Cayley, and later Klein himself, first made prominent. Projective geometry, taken in the abstract, can be developed without the use of any conceptions whatever of metrical relations in space. In other words, projective geometry is a science of spatial order, and not at all of spatial quantity. Cayley and Klein showed how, by the use of certain (once more, very abstract and ideal) assumptions, our ordinary metrical geometry can be made to appear as a highly specialized case of this purely ordinal science. In the light of this consideration, Klein's just cited remark about the contrast between visual space and tactual motor space suggests a very interesting, although a very complex psychological problem about the psychology of the concepts of order and of quantity in their application to space. I suppose that no psychologist would admit that visual space is primarily non-metrical; and, of course, Klein did not mean that it was purely so. For the rest, visual space is obviously related to our consciousness of the results of our movements, and cannot be isolated from them, except by a deliberate abstraction. But, on the other hand, visual space

certainly does present to us the facts which projective geometry isolates; while our other space experiences do not directly involve these projective facts at all. But the projective facts, as logical analysis shows, are, when taken by themselves, non-metrical, while the laws of the metrical facts regarding space are capable of being conceptually defined as very specialized cases or results, under certain ideal conditions, of the laws of a non-metrical space-world. These considerations may not prove to have important results for the psychology of our concepts of order and of measure; but as they stand, they certainly suggest genuine problems for psychological scrutiny. I wonder, then, to find them so little regarded by the psychological students of the space problem.

In a somewhat different direction various contributions to the questions about our consciousness of space have been made, within the last few years, by M. Poincaré, who has here shown, not only all the knowledge of a great mathematical investigator, but also a decided effort to translate his analyses into psychological terms. These contributions of Poincaré, following the results of Lie and others, have laid stress upon the relation between our general spatial conceptions and the mathematical theory of 'groups'; and they promise in still another way to bring to pass connections between psychological and mathematical investigations. In view of such developments, I feel that the time is approaching when no psychologist will have a right to try to contribute to a knowledge of our space-consciousness, so long as his own geometrical conceptions are still confined to those of the mathematical text-books of his early youth. Psychological space theories must be brought into explicit relation with mathematical theories.

V.

But I must hasten from this mention of the merely mathematical investigations to a still more summary reference to similarly analytic work that has been done in other fields of the logic of science. The books of Mach, whose name I have already mentioned, are surely known to many of you. Dr. Paul Carus has proved, as editor and as director of translations, a bene-

ficent aid to our students in this country by making literature of this type widely accessible amongst us. And you surely know the spirit of much of this modern literature of the logic of science. It is characterized, first, by a certain measure of the same sort of critical skill which has made the modern mathematicians so rigid in their methods of proof, and so critical of their first principles. To be sure, outside of pure mathematics, you seldom meet with the degree of rigidity which that science has of late so carefully cultivated; but still the spirit of watchful self-analysis, the freedom from sacred and unquestionable dogmatic presuppositions of all sorts, the willingness to consider fairly the possibility of the opposite of any once asserted proposition, are the common features which characterize Mach, Pearson, Hertz, and the other typical writers of this recent movement. Even as I have been preparing this discussion there has come into my hands the *Vorlesungen über Naturphilosophie* of Ostwald—a book of whose charm a reading of the first half of the lectures has already convinced me, and whose logical spirit, whatever you may think of its results, is of the most delightful and wholesome. The researches of which such literature is the representative, are characterized by a view of the nature of the thinking process which is closely allied to that which the mathematicians have gradually developed. For one thing, human thought, in the view of such modern writers, is not bound by any one definable collection of unquestionable axioms, nor yet limited in its operation by any mysteriously predetermined set of irreducible primal concepts. It is a variable and progressive process that is concerned with the adjustment of conduct to experience. In place of unquestionable axioms, one has therefore, in any science, only relative first principles, resolutions, so to speak, to treat some portion of the world of experience as describable in certain terms. The immediate purpose of any thinking process in a special science is the description of experience, and is not what used to be meant by the explanation of facts. To describe experience is to construct a conceptual model that corresponds, point for point, so far as desired, with the observed phenomena. In order to construct this conceptual model, one has to set about

one's work with a definite plan of action, a plan large enough and coherent enough to cover the intended range. One's provisionally assumed first principles, or, as such writers often say, one's postulates, are therefore chosen simply, as expressions of this coherent plan of action. One constructs one's model according to these postulates, compares the results with the facts, and is judged accordingly. Meanwhile, a paucity of elementary assumptions is to be preferred, because science, as a practical activity, loves economy. Such writers use the older forms of the principle of causation either not at all, or as sparingly as they think possible,—their reason being that they are not quite sure what the principle of causation used to mean, and that they have a great fondness for entirely overt, sharply definable and clearly verifiable relations amongst phenomena, so that they are interested only in finding such relations. But causal explanations, as formerly conceived, seem to them to have supposed the true connections of facts to be founded in something behind the scenes, which no experience could ever bring to light. Such writers therefore seem to themselves to be working in a purely positive spirit, as August Comte long ago, although in a much cruder fashion, advised us to work. They often, like Mach and Pearson, call themselves anti-metaphysical. Yet, as a fact, all this analysis of the structure of the thinking processes of the special sciences, and of what I have elsewhere called the world of description, seems to me to be not only in no wise inconsistent with an idealistic philosophy, but to be a most fruitful auxiliary to such an idealistic interpretation of the facts of the universe as, in another place, I have had occasion to maintain. But here is no place for considering the philosophical value of such a view of the logic of science. What I am here concerned to show is that this effort so to expound the principles of science as to make all the assumed relations between the objects of one's thought overt and exact, rather than occult and inscrutable, relations, leads of necessity to an analysis of the process of thinking which is full of psychological suggestiveness. For a similar reason, this effort to justify scientific theories solely by their success in producing conceptual constructions that correspond in definite and controllable fashion with

the phenomena, leads to a sort of practical theory of the business of thinking which closely relates the point of view of the logician to that of the psychologist. For the latter must view the thinking process as one of adjustment to the environment; and he must suppose the mental motives which determine the choice of one rather than another way of thinking to be in the long run determined, as to their natural history, by the success of one method of adjustment as compared with that of another.

In consequence, I maintain that the future study of the psychology of the thinking process will have much to gain from a use of such analyses of ideas and processes as this new science of the comparative morphology of concepts will, as it further develops, bring to light.

VI.

My hastily-made catalogue of the types of researches which belong to the second of my two classes of recent logical inquiries is thus, within its present very narrow limits, completed. I must still try briefly, however, to lay stress upon a very important general feature of the thinking process which all these recent researches, whether in the specially mathematical field or in the wider field of the logic of the various natural sciences, seem to have brought to clearer light. So long as logicians were largely confined in their researches to results derived from the analysis of language, the problems which they could hand over to the psychologist were principally the classic, but as I think, relatively fruitless problems, to which Ribot's and Marbe's experimental researches have been devoted—such problems as, What has one in mind on hearing an abstract word pronounced? or, What happens in my mind when I judge that A is B? We have already seen that the modern mathematical researches have prepared for the psychologist a large collection of relatively new problems relating to our consciousness of the types of serial order, and relating also to the way in which this consciousness of order is linked to our ideas of quantity, of space and of continuity in general. Many of these problems have assumed, in modern mathematical researches, decidedly instructive forms, which are now nearly if not quite ready for experimental study. But the problems which modern logical research

is preparing for the psychologist are by no means limited to these. Let me call attention then to another range of problems of a very complex character, but of a type especially likely to receive, I think, ere long, a form suited to novel experimental researches.

Psychologists have already elaborately studied, in the laboratories, our consciousness of the differences between presented objects of various sorts. But a difference between two sensations, or intervals, or other presented facts, is a matter rather of perception than of more elaborate thought. We judge such a difference indeed; but the judgment occurs as a sort of more or less swift or deliberate reflex, subject to no conscious logical principles, except those implied in every least effort to attend to the facts presented, and to report accordingly. Even in such an effort, however, there appears one element that, in the life of our more familiar and complicated thinking, assumes extremely varied and important forms. The subject in a series of experiments upon just observable differences is obliged to report whether two objects appear to him to differ or not to differ in an assigned respect. Upon this side his act of judgment includes what one may call the 'yes' and 'no' consciousness, the decision as between alternatives, the selection or suppression of a certain possible response to an object. But the 'yes' and 'no' consciousness is one that is of course not limited to the case of observing small differences, but that has applications wherever we are able to judge; and one of its most important applications appears whenever we not only observe the differences of objects, but, in some more elaborate way, *classify* objects. Two objects, such for instance as a triangle and a circle, are in two such different classes for us (when we do judge them as figures of different classes), not merely because we observe that they are for us different in shape, but because, in the presence of one of them we are disposed, in view of our geometrical training, and even of our purely popular habits of thought and speech, to make certain responses, to perform certain deeds, which, in the presence of the other object we should, if these deeds were suggested, suppress, reject, inhibit, as unfitting, absurd, untrue. In presence of the circle we do not only tend to follow its con-

tour by means of certain eye movements, and to have suggested to us certain names, memories, and æsthetic impressions; but, if we are thinking about circles we consciously accept certain of our suggested motor responses in presence of the circle, as adapted to express what it means for us, and how it is related to the rest of our life. Some of these very responses to which, in presence of a circle, we thus, so to speak, say 'yes,' are amongst the ones to which, in presence of a triangle, we say 'no,' in case there then arises any suggestion of our making them. Our customary summary expression of the results of many such acceptances and rejections of fitting reactions in the presence of circles and triangles takes the form of saying that 'no circle is a triangle.' This assertion is of course not the same as the assertion that our representative ideas of circle and triangle are different ideas. One's idea of a Frenchman differs from that of a dancing master. But it is absurd to say that because one is a Frenchman he cannot be a dancing master. Our assertion about circle and triangle is that they are not merely different, but belong to mutually exclusive classes. And we define for ourselves this latter fact of the mutual exclusion of the classes by means of a series of processes in which the consciousness of presented or remembered differences is bound up with the 'yes' and 'no' consciousness in a fashion that the logicians and psychologists of all ages have attempted to unravel, and that the psychologists, at least, have failed to discuss with finality, just because they have so little studied the 'yes' and 'no' consciousness, either in itself, or in its relation to our consciousness of difference.

As for the logicians, with their Eulerian diagrams, and their more recent and exact symbolic notations, they have indeed done much to clarify the more formal aspects of the conceptual relations involved in exclusions and negations; but, as Professor Ormond's paper on the place of the negative in logic showed to this association some years since, the questions here involved are amongst the most delicate and fundamental known to thought, and they are not yet closed issues. What, then, is the precise relation of the consciousness of difference to the consciousness of negation, or of mutual exclusion? Both logi-

cians and psychologists need to study this problem more thoroughly.

But now it is just here that the modern reëxamination of the principles of the various sciences has been enlarging our ideas of the importance of the function of what I have called the 'yes' and 'no' consciousness in all our exact thinking. When I first heard about the logic of science, I was told by my teachers that the stage of a science in which it made much of classifications was a relatively imperfect stage. A science, I was told, passed to a higher stage when it learned to substitute explanations for classifications. And its explanations, in their turn, became exact whenever they passed to the highest stage of scientific knowledge, where they became quantitative. Quantity, then, was a concept of a rather mysterious dignity; but it certainly belonged to some very lofty level of thinking, where mere classifications were no longer in question. When one reached this lofty level science became mathematical, and the goal was near.

But nowadays, our new comparative logic of the sciences seems to put this whole matter in a new light. The ideal of exact special science is still mathematical, and will always remain so. But then, for one thing, mathematics, for the enlightened, is no longer merely the science of quantity, but is rather the science of exactly definable relationships of all types. Quantity itself, however, appears, in this new logic, as a conception whose properties and laws, in all the numerous branches of the science of the different kinds of quantity, are definable only in terms of the properties of certain manifolds, or complexes of ideal objects, which are called number-systems. The number-concept, which, as I before pointed out, is for the modern mathematician very prominently an ordinal concept, has become, in its various modern forms, something more general, as well as logically more fundamental, than the concept of quantity. Our exact knowledge of the laws of quantity thus tends, more and more, to appear as founded upon our knowledge of the laws of number, the latter being deeper and more universal. The result is the tendency towards what Klein has called the *Arithmetisirung* of mathematical methods. Now this *Arith-*

metisirung implies in part, making prominent, as I pointed out earlier in this paper, the ordinal concepts. But it also implies ***giving a prominence to exactly defined classifications which I suppose has never before been known in the history of science.***

Our knowledge of number-system is, in very large measure, a knowledge that there are, in each system, these and these classes of numbers, and that of every number in one of these classes one can assert what one must deny of every other number in the system. Dedekind's famous and epoch-marking definition of the irrational numbers as corresponding to the totality of the classifications or *Schnitte* that one can make in the series of rational numbers, is one brilliant instance amongst many of the way in which classifications have become important in modern exact science. Another instance is Georg Cantor's definition of the grades, or dignities, the *Mächtigkeiten* of infinite assemblages of objects. The discovery of this new concept by Cantor seems to me one of the most brilliant feats of constructive imagination in recent times. It has enriched mathematics, and will enrich future philosophy, with wholly new views of the problem of the Infinite. Yet it turned upon a beautifully simple application of an exact principle of classification. Modern algebra, in the conception of what are called 'domains of rationality,' has again used an obvious and fundamental principle of classification, whose application to systems of numbers is very vast, and whose value in very various sorts of problems appears to be immeasurable. The most modern researches into the principles of geometry, and of the other exact sciences, in their efforts to find a sufficient and closed system of mutually independent first principles, have shown how much is gained by exactly classifying the ranges, or domains, to which various principles can be said to apply. Even the single principles, taken by themselves, appear, when thus examined, to be simply classifications of facts. Thus the principle that any two points in a space determine one straight line, while two straight lines can have but one point in common, is for certain purposes best stated as a classification of the points of space. These points namely are such that, if you choose at random any two of them, these two determine one class of

points such that every point in space either belongs or does not belong to that class, while no two classes so determined have more than one point in common. Thus stated, the principle regarding straight lines and points appears as it ought to appear; namely, it appears as no self-evident axiom, but as a surprising and even baffling property of the points in space, and so as an arbitrary fact of our spatial experience. It is as if you said: "There is a nation of men somewhere such that any two men in that nation belong to one exclusive club, to which every other man either does or does not belong, while no two such clubs have more than a single member in common." Such a nation would have a strange sort of club-life. But just such an assemblage are the points in space.

Classification from such a point of view reigns then everywhere on the highest level of exact science. Sharp classification is the goal as well as the beginning of the thought that gets embodied in the special sciences. To say 'yes' or 'no' to the question: "Does this object belong or does it not belong, for this purpose, to this collection of objects?" is the last as well as the first task of the human thinker in all his dealing with particular facts. Now the logical interest of this generalization about the nature of science lies in the consideration that, from this modern point of view, for which the special sciences, as you remember, are descriptions of phenomena, all our valid explanation of facts, just so far as they are valid, all our knowledge of the laws of nature, all our quantitative insight into things must be reduced merely to such classifications of facts, and to serially ordered systems of such classifications. Of such materials our conceptions of what I have called our world of description must consist. One modern writer has explicitly made this very generalization. I refer to Mr. A. B. Kempe, in his paper on the 'Theory of Mathematical Form.' Mathematics, according to Mr. Kempe, who illustrates his notion in a very varied way, is purely a science of exact classification, and is nothing else. It defines the relations of objects and systems of objects by classifying certain of these objects, or certain pairs, triads, or other groups of these objects, by placing certain of them together, and by distinguishing them

from other objects or assemblages of objects. Thus, according to Mr. Kempe, one studies geometry in a strict logical order by beginning with the conception that the points of space are, as mere points, undistinguished one from another. One then goes further and notes that not only all points, but all pairs of points in space, may be regarded as undistinguished from one another, so long as you ignore the notions of direction and distance. One next observes, however, that if one takes account of *triads* of points, one has forthwith a classification of such triads, because all collinear triads of points are distinguished from all non-collinear triads. Upon the basis of this primal classification, as Kempe holds, all the rest of geometrical knowledge can be built up by adding further classifications as new principles are introduced. Every new principle means merely a new classification. And this procedure, as Kempe holds, is typical of the processes of exact thought everywhere. Science, then, consists altogether of classifications.

Now what I want to point out is the enormous importance that such considerations give to the function which, in the life of our thinking, I have called the 'yes' and 'no' consciousness. This, I have said, is the consciousness wherein we are aware of accepting or inhibiting certain acts—acts through which we treat two or more objects as belonging to one class, or as belonging to classes that exclude each other. The contrast of X and not-X is always a product of the working of such a 'yes' and 'no' consciousness. Now I have said that psychologists have too much neglected the closer study of the 'yes' and 'no' aspect of consciousness. Psychologically speaking, it is that aspect of our mental life which accompanies our attitudes of readiness to perform certain deeds, and of attendant readiness to inhibit other deeds. Here then is a place where the modern logical inquiries counsel the psychologist to undertake a more careful study.

As a fact, classifications depend, for us, *upon inhibitions, and upon becoming conscious of our inhibitions*, and also upon bringing to notice the positive motor tendencies that are in us correlative to these inhibitions. Those who have studied abstract ideas as Ribot has done, or judgments as Marbe has done,

have therefore attacked the problems of the thinking process at the wrong end. They have tried to examine the corpse of a dead thinking process. They have found little left but a reflex act. Live thinking is the process of classifying our objects by suppressing, in their presence, certain of our possible motor acts, by welcoming, emphasizing, or letting go certain of our other acts, by becoming aware, somehow, *i. e.*, in some conscious terms, of these our positive tendencies and inhibitions, and by them regarding the objects in the light of the deeds that thus we welcome or suppress.

The most promising problem about the whole thinking process which is thus suggested to the psychologist may then be defined as this: "In what way, to what extent, and under what conditions, do we become conscious of our inhibitions?" Plainly the negative principle in consciousness, the *Geist der stets verneint*, is the constant accompaniment of all our higher, our organized, our thoughtful activities. It is the principle which makes exact classifications possible. And descriptive thought, in the light of these modern researches, means exact classification, and means nothing else so much. It is by contrast with our inhibitions that our positive motor processes get their precise conscious definition, as inhibitions of inhibitions, as tendencies to act by means of overcoming opposing considerations, and as assertions that are at once coördinate with, and opposed to, denials. Our abstract ideas are products of such an organized union of negative and positive tendencies. We can therefore understand the psychology of live thinking processes only in case we understand *when, how far, and under what conditions, inhibition becomes a conscious process.*

But now the psychology of the inhibitory processes—how vast a range of interesting phenomena, and how imperfectly explored a territory, does not this name suggest to us all? The world of the phenomena of primitive *tabu*, how fascinating it seems! Yet with *tabu* human thought about certain of the exact classifications, both of conduct and of truth, would seem to have begun. The pathology of our inhibitory consciousness, how interesting its complications—how important clinically—how significant from the humane point of view! Some years

since, in a paper on the case of John Bunyan, I tried to present to the members of this Association an instance of the descriptive psychology of an experience largely made up of pathological inhibitions, occurring in the early manhood of a great genius. You all know how rich is the clinical material for the study of such cases. But the experimental psychology of the consciousness of inhibition—here surely is another extensive, accessible, and comparatively much neglected, and at the same time perfectly definite and promising field of work. I have now tried to show you that modern logical inquiries, in emphasizing the central significance that the process of classification possesses in all grades of our thought, have made more evident than ever that upon an understanding of the psychology of inhibition must depend a great deal of our further advance in a knowledge of the psychology of the thinking process.

I conclude then by urging upon my fellow members (1) the problem of our inhibitory consciousness and (2) the before-mentioned problem of the psychology of our ordinal concepts, that is, of our consciousness of ordered series of objects, *as the two great tasks that are set before the students of the psychology of the thinking process by the results of modern logical inquiry.*

If anything that I have said shall tend to further the mutual understanding between workers in psychological and in logical research, I shall be amply repaid for my efforts in trying thus to state to you something of what I see in the present situation of logical inquiry; while you, I hope, may in that case be not wholly unrepaid for the tediously abstract and lengthy road over which, by your kindness, I have been privileged to lead you.

PROCEEDINGS OF THE TENTH ANNUAL MEETING OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION, UNIVERSITY OF CHICAGO, CHICAGO, ILL., DECEMBER 31, 1901, JANUARY 1, 1902.

Report of the Secretary.

The tenth annual meeting of the American Psychological Association was held at the University of Chicago on Tuesday, December 31, 1901, and Wednesday, January 1, 1902, in affiliation with the American Society of Naturalists. As the same time and place had been set for the annual meeting of the Western Philosophical Association it was decided to make the meeting a joint one of the two associations and this plan was successfully carried out in the sessions of Tuesday morning and Wednesday.

President Royce of the Psychological Association presided at the joint meeting on Tuesday morning and President Thilly of the Philosophical Association occupied the chair at the meeting of the Experimental Section on Wednesday. Thirty members of the Psychological Association were in attendance at the sessions.

At the regular business meeting of the Association held on the 31st, the following was transacted. Election of officers for 1902: *President*, Professor E. C. Sanford, Clark University; *Secretary and Treasurer*, Professor Livingston Farrand, Columbia University; *Members of the Council to serve for three years*, Professor George S. Fullerton, University of Pennsylvania, and Professor G. T. W. Patrick, University of Iowa. The following new members were elected: Professor H. Heath Bawden, Vassar College; Professor George A. Coe, Northwestern University; Professor Edwin G. Dexter, University of Illinois; Professor J. J. McNulty, College of the City of New

York; Professor Walter B. Pillsbury, University of Michigan; Professor Walter D. Scott, Northwestern University; Professor Walter Smith, Lake Forest University.

Upon request of the President of the American Association for the Advancement of Physical Education that the American Psychological Association appoint a representative upon a Committee on Statistics and Measurements, Professor Cattell was appointed the representative of the Association.

Upon request that the association appoint a committee of one to coöperate with similar committees from other associations in collecting and preserving speech records of various languages, dialects and persons, Professor Sanford was appointed as such committee.

The report of the Committee on Bibliography was received and placed on file and as a substitute the council recommended the following which was adopted: That a committee of five be appointed by the President, and that this committee be instructed to report at the next annual meeting of the association upon the subject of a psychological bibliography, including contents, plan of arrangement and of publication, and in their report to take into consideration all available existing material. The President appointed the following to serve as such committee: Professor Warren, Chairman, and Professors Sanford, Creighton, Sneath and MacDougall.

The Council also recommended that members of the American Psychological Association living in any center may, with the authorization of the Council, organize themselves into a local section for the holding of meetings. This recommendation was adopted and the establishment of branches in New York, Cambridge and Chicago was authorized.

REPORT OF THE TREASURER FOR 1901.

DR.

To balance at last meeting	$1,222 53
To dues of members	363 00
To sales of Proceedings	25
	$1,585 78

Cr.

By expenditures for		
Printing	$25 69	
Postage	18 25	
Stationery	2 00	
Clerical assistance	12 50	
Expenses of Baltimore Meeting	2 88	$61 32
Balance		$1,524 46
Interest on deposits (approximate)		120 00
Total		$1,644 46

Audited by the Council.

LIVINGSTON FARRAND,
Secretary and Treasurer.

ABSTRACTS OF PAPERS.

Address of the President: *Recent Logical Inquiries and their Psychological Bearings.* By JOSIAH ROYCE.

(The address appears in full in this number (March) of the PSYCHOLOGICAL REVIEW.)

The Interpretation of Savage Mind. By JOHN DEWEY.

(The paper appears in full in this number of the PSYCHOLOGICAL REVIEW.)

The Theory of Induction. By FRANK THILLY.

Some writers distinguish between scientific induction and unscientific induction, but regard both as forms of induction (Bacon, Mill, Veitch, Lotze, Wundt). Others reject the unscientific form or simple enumeration, and accept only that phase of induction which derives from particular facts the law of their necessary connection (Sigwart, Ueberweg, Bosanquet, Shute, Hamelin, Hibben, Creighton). Of these some identify induction with scientific method in general, including the forming of hypotheses, deducing their consequences, and verifying them (Sigwart, Jevons in 'Principles of Science,' Hamelin). According to some thinkers, only so-called perfect induction is certain; imperfect induction is only probable. Nearly all agree, however, that induction is grounded on the principle of the uniformity of nature. This principle is interpreted differently by

different thinkers, sometimes merely called by another name. Some speak of it as the principle of identity: what is once true will always be true; whatever is will remain so; the world is identical with itself (Lotze, Kromann, Bosanquet). Some express the same idea by saying the particular is the expression of the universal (Aristotle, Hegel). Some call the principle the principle of necessary connection; the given is necessary (Sigwart, Ueberweg, Hibben, Welton, Creighton). Some identify it with the law of causation (Mill, Jevons, Veitch, Benno Erdmann). Moreover, the principle of the uniformity of nature is conceived by some as a postulate of our thinking (Sigwart, Lotze, Kromann, Bosanquet, Hibben, Welton, Creighton), by others as the product of experience (Mill, Jevons, B. Erdmann).

The author's conclusions are: (1) Hasty and imperfect induction is just as truly induction as scientific induction. (2) Induction is not limited to the discovery of causal relations. (3) Induction does not discover only the inner, necessary relations of things. (4) Induction must not be identified with scientific method in general, for this includes both induction and deduction. The logical thing to do is to restrict the term induction to the process of inferring a general truth from particular instances, and to use another name for the combination of this process with deduction. (5) It is not true that we base ourselves on the principle of the uniformity of nature in induction, that is, that inductive inference is really deduction. Induction consists in making the so-called inductive leap, which must be regarded as a natural function of the mind. The principle of the uniformity of nature is a late product of experience, the result of induction, and not its ground.

On the Relative Frequency of Ideas. By CHARLES S. MINOT.

(No abstract received.)

The Psychology of Causality. By W. B. PILLSBURY.

For the psychologist causality is a mark which attaches to two successive events and sets them off as related in a different and more intimate way than if they are merely successive. There are two questions which must be raised to define and

explain this relation. The first is what is the nature of the characteristic mark of causality, the second to determine the mental conditions under which it attaches to the successive processes.

The mark of the causal relation is shown by introspection to be largely made up of a feeling of strain or effort which is attached to object thought as cause. This anthropomorphic tendency to ascribe activity like our own to objects which are regarded as effective seems to pervade all thinking. Words, such as exert, pull, force, which are found on every page of works on physics all bear testimony to the widespread influence of personification, in our idea of cause.

The second aspect of the problem is still psychological, and we need to consider, not the question of the absolute truth of the causal connection, but merely the truth relative to the individual consciousness in which the two events occur. For an answer to this question as to the conditions under which the mark of causality appears we must look not to the frequency or intensity of the connection as did Hume and his successors, but to the influence of the related ideas. If we translate Bosanquet's treatment of the system of knowledge from absolute to concrete terms, and make it apply to the individual experience instead of the abstract universe, we should obtain a statement of the nature of the relation. And it must be possible to make the translation, for the elements of knowledge which he unites into a system are in the last analysis but mental processes of some kind, in spite of his violent protestations to the contrary. When the process is conscious the causal relation is confirmed by reference to analogous relations already regarded as causal. But much of the process is unconscious, and then the process owes its origin to the reinforcement of related experiences themselves unconscious at the time. The solution suggested would amount to a translation of Bosanquet's system of knowledge into Stout's apperceptive systems.

A Method of Measuring Mental Work. By C. E. SEASHORE.

In what sense can we speak of measuring mental work? What significance and value do such measurements have?

These two questions were discussed in the introduction. Then followed a description of an instrument and methods of measuring with it. The instrument has been given the descriptive name 'psychergograph' because it is used in making graphic records of mental work.

The aim in the designing of the psychergograph was to devise means by which one can (1) call forth a relatively simple and definite complex of mental activity, (2) repeat the same for any length of time, without interruption, and (3) measure (*a*) the amount of work done, (*b*) the time taken, (*c*) the quality of the work, and (*d*) fluctuations in speed and quality. As an example of the kind of work that may be measured, we may mention a case of simple discrimination denoted by the following setting: Given one of four known signals, to recognize it and make the corresponding one of four simple responses.

The psychergograph consists of two distinct parts, the stimulator and the recorder. The stimulator makes a series of quick exposures, the order of the signals being determined by chance. It has four reaction keys, each bearing a signal for selective reaction. Each reaction brings out a new signal and the process may be repeated without interruption as long as may be desired. The recorder furnishes a continuous tracing of the action of each of the keys in the stimulator; also a time-line. The record is made on common telegraph tape by electro-magnetic pencils. It shows, along a time-line, the duration of each act as well as the time of the whole series. It also shows the number of errors and the nature of each error. From the experimenter's point of view the operation is completely automatic. He has only to press a button to start the recorder and give the signal to begin. The personal equation of the experimenter is therefore eliminated. The records are permanent and may be read at leisure.

The record thus obtained is supplemented by description of the condition of the observer, by an introspective account rendered by the observer after each test, and by observations made by the experimenter during the test. The psychergograph gives an accurate, unbiased record, but the significance of this depends upon our ability to account for the conditions which are elements in the process measured.

A great variety of measurements may be made. In fact, all the complications of the usual reaction experiment may be introduced with the additional possibility of uninterrupted repetition of the same process for any length of time.

(A full account will appear in Vol. III. of the University of Iowa Studies in Psychology.)

Class Tests in Psychology. By JOSEPH JASTROW.

Many of the tests devised to determine the functional efficiency of a given process or group of processes would acquire greater applicability if they could be so arranged as to be applicable to a class of individuals instead of to each individual separately. This situation appears as a practical problem more frequently in collecting data in the schoolroom than under any other special set of circumstances. If one can collect data upon forty individuals in the same time as upon one the gain is sufficiently obvious. Hence it seems worth while to inquire what are the general requirements that will transform the one type of test into the other. The first is that the test shall be self-recording. In a great majority of individual tests the function of the experimenter is largely that of a recorder. If the record itself yields the material needed for the calculation of the results, then the test becomes a class test. Frequently a slight modification is needed to bring about this desideratum. In questions involving time tests, it can be accomplished by measuring not the time needed for a single performance of a simple or complex reaction but the quantity of such reactions that can be consecutively done for a given period. A second principle is that a simplification of apparatus is required; this not only because it must be duplicated as many times as there are individuals in the class, but equally because a device that shall be handled by the uninitiated must be simple. A satisfactory test of the judgment of lengths of lines can be obtained by printing triangles all of which have two sides alike in length but a third side differing more or less from the other two, and then requiring that the unequal side shall be indicated. The same test can be arranged for the sense of touch by having triangles cut out of cardboard, which are to be placed in a box with the short side upwards.

With simplification of apparatus and an automatic record of the result by tabulation of the amount of work done, by indication of errors, by marking off certain selected traits of a sense-impression, by recording by position or arrangement, etc., a large range of tests can be reduced to the class type. Even where an apparatus can be handled only by one person at a time, results may be quickly accumulated if it be arranged that the directions are explicit and the machine is self-recording. In some cases, too, it is possible to make the test in couples, allowing one person of each couple to act in turn as subject and as experimenter or recorder. The psychologist, like all other workers, must be saving of men and of time; there is no more pressing demand upon him in this respect than economy in the arrangement of tests so that the accumulation of results shall not involve too extravagant an outlay in material, time, or assistance. The class test is a step in this practical endeavor.

The Effects of Practice on Illusions. By CHARLES H. JUDD.

This paper reported experiments in which two subjects made a large number of quantitative determinations of the strength of the Müller-Lyer illusion, for the purpose of discovering the effects of practice on the perception of this illusion. For both subjects the illusion disappeared in about 1,000 determinations, although one subject expected the change and the other was wholly ignorant of the purpose and results of the experiment.

In the case of both subjects, the effects of practice with one figure were transferred to a variety of different figures. One special case of such transfer is of interest. The subject who did not know that the illusion had disappeared showed a very pronounced increase in the illusion when the standard line was transposed from the right to the left side. This negative transfer of practice was more significant because it showed no tendency in a long series to weaken or disappear.

(This paper has appeared in full in THE PSYCHOLOGICAL REVIEW for January, 1902.)

Mental Imagery of Students. By F. C. FRENCH.

(This paper has appeared in full in THE PSYCHOLOGICAL REVIEW for January, 1902.)

The Duration of the Auditory After-Sensation. By MAX MEYER.

The first attempt of measuring the auditory after-sensation was made by Alfred M. Mayer in 1874 with seemingly full success. The result was that the duration of the after-sensation was inversely proportional to the vibration frequency. In 1898 another method was employed by Abraham. His result was that the duration of the after-sensation was constant, *i. e.*, entirely independent of the vibration frequency. One of the two methods, therefore, must be fundamentally wrong.

Mayer's method was this (neglecting various smaller modifications): The tone was produced by a tuning fork and conducted through a tube to the ear of the observer. The tube was intersected by a disk with a row of openings, so that at rotation of the disk the tone was heard intermittently, but when the velocity of rotation was sufficiently increased the tone appeared smooth, because—as Mayer assumed—the after-sensation was as long as the time interval between two of the beats.

Abraham used an entirely different method. The tone was produced by a siren of which alternately a number of holes in a row were open and closed. At a first glance it seems possible to increase also in this case the velocity of rotation until the interval between two beats is as short as the after-sensation, when the tone should be smooth. However, the tone will never be smooth in this case, as the intensity of each beat does not abruptly begin and end, but rises and falls in a certain manner. A series of such rising and falling tones cannot appear as a smooth tone unless the fall of each preceding and the rise of each succeeding tone be perfectly symmetrical, which is quite improbable. Under these circumstances we cannot make use of smoothness in order to determine the duration of the after-sensation. Abraham, therefore, used a siren with two rows of holes, producing two different tones, and being so arranged that one tone is sounded while the other pauses, and *vice versa*. At rapid rotation of the siren a trill is heard, but when the pauses are filled up by the after-sensation, no trill is heard, but two *simultaneous* tones. The unavoidable roughness is then

without any consequence, and the result is that the after-sensation is constant, *i. e.*, independent of the pitch.

The wrong method is the one used by Mayer. That the tone becomes smooth when the rotation is rapid, is not caused by the pauses being filled up by the after-sensation, as Mayer assumed, but by an entirely different condition. When the rotation of Mayer's disk is rapid enough, one vibration of the tone of the fork will pass through unobstructed, the next one will be weakened by the disk, and so on alternately. Then, of course, the tone sensation cannot be alternately strong and weak. Two impulses at least (in a higher region a few more) are physiologically necessary for the production of a tone sensation. If one of these two is great and the other small, not a succession of a strong and a weak tone is heard, but a single tone of invariable intensity. There is no cause at all for a fluctuation of intensity, and the tone is smooth; but no duration of an after-sensation is measured by this observation.

We now also comprehend Mayer's—unfounded—assertion that the duration of the after-sensation was inversely proportional to the vibration frequency. If we take a tuning fork an octave higher and wish to let one vibration pass through the tube unchanged, the next one weakened, etc., we have of course to increase the velocity of rotation twice; but this does not permit any conclusion as to the duration of the after-sensation in the case of this higher tone. *I. e.*, the seemingly beautiful method of Mayer turns out to be no method at all.

The Theory of Rhythm. By ROBERT MACDOUGALL.

(This paper will appear in full in an early number of THE PSYCHOLOGICAL REVIEW.)

A Biological View of Perception. By THADDEUS L. BOLTON.

The inapplicability of the old categories of psychology to modern experimental and comparative methods is generally recognized. The purpose of this paper is to revise one of them in the light of some ideas borrowed from biological study. Much that enters into the perception of an object has been overlooked. The older psychologists proceeding by the method of

analysis have penetrated only so far as to discover the elements contributed by the direct afferent currents initiated by the object presented. These are the most obvious as well as superficial elements. The active part of perception needs to be emphasized, the part which arises through the reaction of the organism upon the object. When we trace perception down in the animal scale to its earliest beginnings, we find it generally fading into automatic and instinctive performances. Perception reduced to its lowest terms is an act and as such it is synonymous with instinct and emotion. Objects that arouse no instinctive or emotional response are perforce unperceived by animals. Even in man this acting in view of objects still enters largely into the perception of them. Perception is, therefore, an attitude towards objects. Beginning as perception does in instinctive performance, percepts must be regarded as more or less refined emotions.

Mental and Moral Heredity in the Royal Families of Europe.

By FREDERICK ADAMS WOODS.

The following is an abstract from an extended investigation to disclose the strength or weakness of heredity as a factor in the formation of character in a large number of interrelated individuals where known pedigrees and characteristics are obtainable and open to the verification of anyone who should question their exactitude.

By taking all persons present in complete family records there is no selecting of instances to support any theory. Also the opportunity to obtain sufficiently complete records of all on the maternal side is an advantage over any previous work. The inclusion of mediocrities and those of low intellectual standing as well as geniuses is of interest, since it shows the heredity effects of all the different classes of minds on each other. The study of various moral qualities in their relation to heredity has never been carried on to any extent in a systematic way with complete pedigrees, and considerable light has been thrown on this question through a study of Royalty. The houses included are the following: Hanover in England, Saxe-Coburg, Saxe-Saalfeld, Brunswick, Hohenzollern, Denmark, Russia, Sweden,

Savoy, Saxony, Spain, Portugal, France, Netherlands, and the Hapsburgs in Austria and Italy. The years covered extend in general back to the sixteenth century, through four centuries further in the countries Spain and Portugal. 564 persons have been correlated for intellectual grades and 487 for moral. Since, in general, the same person occurs first as a remote descendant, then as a near one and subsequently as an ancestor, and since there is considerable intermarriage, these figures have much more value for scientific purposes than their size would at first indicate. Besides this, as a separate investigation, the relation of genius to mediocrity has been studied among 3,312 non-selected interrelated royal and noble persons whose scientific value, owing to repetitions, is estimated at 32,768.

The persons were ranked in ten grades in relation to each other, one number being given for intellect and one for morality, virtues of any sort being included under this head. A number of authorities were used in estimating each individual, all adjectives were taken down and it was found contrary to the expected that the authorities only rarely disagreed with each other and usually on the less essential aspects. Attention was paid to the law of deviation from an average. According to figures given only a few are in the very high or low grades.

The results show in every separate country an incontrovertible argument that heredity is the main if not nearly the entire cause of the intellectual eminence which these men and women have achieved in relation to their fellows.

The remarkable curve of distribution supporting Galton's law, and falling off from the geniuses where the qualities have not been kept up through fortunate unions, cannot be due to environment as some may contend where different social grades are compared as in the studies of Galton (Hereditary Genius) and Ellis (British Genius). Everywhere is noticeable the following principle which, as far as I know, is new and should be coupled with Galton's law when studying mental or moral heredity—that the hereditary intellect of a person is not likely to represent a blending of the various ancestral traits, but is likely to take largely, though not entirely, from some one of his various ancestors, usually a near one, less and less occasionally a remote.

The results on the moral side are compatible with the theory of heredity, but it is more difficult to separate the influence of environment. However, the applications of the above principle to the countries separately and comparatively have led to the conclusion that here also heredity is probably the main cause. Free will has apparently been of little or no consequence as a cause for their achievements.

The World and the Individual. By W. CALDWELL.

This paper was a critical study of Professor Royce's two volumes of Gifford Lectures. What R. gives us is a basis for the philosophy of religion in a theory of being founded upon an interpretation of human experience. His volumes constitute the most extended and the most closely reasoned expression of the philosophy of dynamic idealism that we possess in English. He begins with the motor aspects of mental processes and (in metaphysic) with the accredited results of Kant's critical method, being obviously anxious to overcome the well-recognized defects of 'Neo-Hegelianism.' R.'s theory of being (that it is invariably 'meaning') is at the same time also an epistemology and a teleology. There is thus for him no *hiatus* between being (*i. e.*, 'meaning') and knowledge (*i. e.*, consciousness of 'meaning') and end (*i. e.*, fulfilled 'meaning'). R. gives a better account than does Münsterberg of the 'World of Appreciation' in relation to the 'World of Description.' He also derives important epistemological consequences from the influence of the 'social factor' in knowledge. R. may be criticised for his manner of treating his assumptions, and in not always being explicit enough regarding them. In particular we need to make his thought consistent, a philosophy that shall logically unify his 'World of Appreciation' and his 'World of Description.' R. in admitting that 'the individuality of all things' is still a 'postulate,' 'something that our ethical consciousness demands,' seems to imply that philosophy (in its 'World of Appreciation') is using the hypothetical method just as science does (in its 'World of Description'). What therefore is the relation of metaphysic to experience—determinative of it or determined by it?

Æsthetic Categories from the Standpoint of Social Psychology. By JAMES H. TUFTS.

Among the more generally accepted categories of the æsthetic are: (1) Universality or objectivity or shareableness; (2) disinterestedness, detachment, semblance or make-believe; (3) human or typical significance. We may be made to explain these from the standpoint of individual psychology, *e. g.*, the objectivity of æsthetic value may be attributed to the fact that the eye and ear, which are preëminently the æsthetic sense organs, tend to objectify all qualities apprehended through them. Admitting the partial adequacy of this method, I maintain that although the two judgments, 'I like it (or, it pleases me),' and 'It is beautiful,' may both express æsthetic feeling, the second or objective judgment implies a social reference; universality and objectivity are thus different aspects of the same attitude. The explanation of this social reference may be approached from the standpoint of social psychology.

I. The æsthetic consciousness in its beginnings is connected with art rather than with nature.

II. The relation of the æsthetic (appreciative) consciousness to art is not that of cause, but that of effect. Art has not arisen chiefly to gratify an already existing love of beauty either in the artist or in the public. It has arisen from various other springs—economic, protective, sexual, military, magical, ceremonial, and religious. In some of its forms it is closely connected with plays, but plays usually represent an experimental or tentative expression of some instinct which finds its roots in the serious activities of adult life (Groos). Hence the early products of the related arts are presumably due to instinctive initiative. Art in all its forms may thus be said to have created the taste by which it is now appreciated.

III. The origins of art as enumerated above are almost without exception social. Art has been produced for social needs, and fostered by social occasions. It has served social ends in the struggle for existence. It has been enjoyed by social groups. The pleasurable stimulus of color and sound has been heightened and reënforced by social sympathy. Rhythm is at least powerfully reënforced by common activity even if not

wholly due to it. Æsthetic feeling may then be expected to show its origin in its characteristics.

The considerations presented apply especially to the categories of groups (1) and (3) above. The explanation of disinterestedness or detachment from reality may be sought in the social psychology of the process by which certain serious pursuits have become sports or games. The explanation, so far as it applies to the social reference implied in objective æsthetic judgments, is analogous to Royce's deduction of the categories as necessities of description. Bergson has given an account of the comic from the standpoint of social psychology.

The Epistemological Limitations of Ethical Inquiry. By NORMAN WILDE.

The study of ethics rests upon certain logical principles, common to it with the other sciences, which determine the nature of its problems and its method of explanation.

1. No science has to prove the existence of its own subject matter, but assumes it as part of the common experience of the race, its problem being the understanding of a given material which it neither constructs nor deduces, but finds. So ethics has not the task of deducing or constructing morality, but of analyzing and interpreting an actually given moral experience whose reality is a matter of fact, not of theory.

2. No special science has to prove the possibility of a knowledge about its material, but approaches it directly under the supposition that such knowledge is possible. The scientific problem is as to what is the actual law of any given set of phenomena, not as to whether there *is* such an intelligible law. Similarly ethics has no need to raise the problem of the intelligibility of moral experience, but may proceed at once to the investigation of the assumed moral cosmos. It is no greater an assumption and no less necessary that we live in a common world of ends than that we live in a common world of objects. As rational beings we act upon the supposition that there is an ideal order of experience discoverable by thought both in the spheres of fact and of value, a supposition without which there would be neither knowledge nor conduct.

3. All explanation consists in the exhibition of the common principle involved in any set of particular instances, by means of which these instances are shown as members of a systematic whole. Scientific concepts are the symbols in which the unity in experience is expressed and must bear definite relation to the experience to be explained, varying with each change in the subject matter studied. Distinct kinds of experience demand distinct sets of explanatory symbols. Moral experience consists of judgments of a better and worse in conduct and its unit is not the scientific judgment that A is the cause of B, but the moral judgment that A is better than B. Ethical explanation must consist in the exhibition of the system of such judgments and its symbols must be those of value and not of fact. The concept of causality has no more significance for ethics than has that of obligation for physics. Scientific method in ethics, therefore, though it consists of observation and analysis of actual moral experience, involves the use of explanatory concepts other than those of causality.

Epistemology as an Independent Discipline. By GEORGE MARTIN DUNCAN.

Some Characteristics of the Genetic Method. By EDWARD FRANKLIN BUCHNER. (Read by title.)

The discussion of method in psychology must be regarded as meaning something more than the mere adaptation of instruments to data. The intimate nature of mental science is often disclosed in an examination of the postulates and implications of method, rather than by the declared conceptions elaborated within the science itself. Method thus becomes interpretation; and scientists cannot too frequently ask themselves: How are we going to think in psychology? With all their variations, methods must not be regarded as external to the body of doctrine which they support. The genetic method has been pressing itself forward as the only true procedure in preparing and attacking the problems of psychology. Its usage has proceeded without careful determination of its *differential;* yet it has had a long history. The adoption of the concept 'function' has heralded the application of the method.

Five groups of characteristics of the method are considered. The genetic method is distinguished for its attitude towards psychological material, its differentiation from brain, stimulus and experiment psychology, its disposition of the acute problem of psychological causation, its claim of being the highest and final method of the science, and the variety of assumptions upon an acceptance of which rests the validity of its adoption. The method is extremely selective in accepting its working material from the lower, instinctive, automatic processes, and rejects all but the modified process theory of the soul. It fosters a brain psychology thinly disguised, does not readily unite with the standpoint of psycho-physics, and must, in fine, not lay broad claims to the sole advantages of experiment. The problems of 'causation' are to be removed from psychology absolutely, in order to make room for the substitute conception of genetically related stages; and, true psychological knowledge is to tell us about soul ages, rather than about soul processes. Analysis and the quest for causal explanations are thus eliminated from the science. The method also uniquely regards itself as disposing of the antithesis between a science and its method by uniting them into one final production. All of the foregoing alleged achievements for the science are really dependent upon a number of assumptions. The genetic method is also to be distinguished for its conspicuous relation to error-liability. While it seems that the method is thus subject to very severe criticism, it possesses, on the other hand, many excellent features, which render it valuable for increasing true knowledge.

Shakespeare and Schiller: A Study in Apperception. By BROTHER CHRYSOSTOM. (Read by title.)

Some Aspects of the Religious Motive and the Salvation Philosophy of Schopenhauer and of Von Hartmann. By J. H. LEUBA. (Read by title.)

Abstracts of papers read by members of the Western Philosophical Association will appear in the Proceedings of that association.

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THE INSUFFICIENCY OF MATERIALISM.

BY PROFESSOR G. S. FULLERTON,

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It must ever remain a matter of regret to those who are imbued with the scientific spirit, and who love clear thinking, that the works of Democritus were allowed to perish. When one has wearied one's wings by soaring in the empyrean with Plato; when one aches in every joint after an agonizing struggle with the Aristotelian conceptions of matter, form, moving cause, and final cause; one turns with a sigh of relief to the simpler and clearer teachings of the ancient materialism. The system is easy to understand; its outlines are distinct and may readily be followed by the eye. It reveals itself to one frankly and openly, standing naked in the light of day, stripped of that veil of ambiguous words and unintelligible expressions with which philosophic systems are wont to drape themselves. It informs us that nothing exists save atoms and void space. These atoms differ from one another only in size, shape, and position. They have always been in motion. Their mutual collisions result in mechanical combinations from which are born world-systems, with their varied phenomena. Nothing comes from nothing; nothing becomes non-existent. The cosmic changes are but translocations of material particles, and this truth may be grasped by the reason, though the senses are too dull to furnish direct verification of it. The universe is a universe of matter in motion, a gigantic mechanism, the successive steps in whose development form a limitless chain of causes and effects in no ambiguous sense of those words. The whole of science is summed up in the comprehension of this order of causes.

That Democritus was an unblushing dogmatist, and cheerfully described in detail all sorts of things of which he could have no possible knowledge, seems sufficiently evident. There is a striking difference between the easy birth of the atomistic

doctrine in ancient times, and the protracted labor which resulted in the atomic theory as we have it now. The old world was uncritical, and cheerfully optimistic as to what could be accomplished by speculative thought. The modern world is more cautious, and has a somewhat better realization of the magnitude of its task. Hence the ancient atomism can easily be criticised in detail; and yet its bitterest assailant cannot fail to see that it has grasped with marvellous clearness an idea in which men of science are more and more coming to rest, the idea of the world as a mechanism, the life-history of which is summed up in an unbroken chain of mechanical causes and effects. The teachings of Democritus, modernized in form and rendered a trifle less dogmatic, would not be found to be much out of harmony with what has been said in the preceding paper[1] touching the occurrences which take place in the material world.

I say expressly, touching the occurrences which take place in the material world, for that paper has concerned itself only with matter and the motions of matter, ignoring the existence of anything beyond. The ancient materialism lays down for itself, it is true, the same limitations; but it undertakes, nevertheless, to say something about minds and their knowledge of things, a field of investigation which it can call its own, as we shall see, only as the result of an act of violence which rebaptizes the minds and ignores the existence of their knowledge altogether. Mind is composed of fine, round atoms, and is disseminated through the body. Atoms are discharged from external objects, pass through space to the organs of sense, and mechanically affect the mind; thus arises the knowledge of external things. This doctrine, as it was later developed in detail by the Epicureans,[2] is highly ingenious and, to men at a certain stage of their reflective development, can scarcely fail to be attractive. It differs only in unessentials from the type of doctrine with which we frequently meet to-day, in men of science who have paid little attention to philosophical disciplines and are unacquainted with the history of speculative thought. They do not speak of mind-atoms, but there is much talk of the external

[1] THE PSYCHOLOGICAL REVIEW, Jan., 1902.

[2] See Lucretius, De Rerum Natura, III.

stimulus, of the organ of sense, of the sensory tracts, of the central nervous system, of the motor reaction. There is also a tacit assumption that with an exhaustive investigation of all these, the whole field is covered. Yet it is clear that both the ancient and the modern materialism simplify their task by dropping out of sight what is most obscure and elusive, and fixing their attention exclusively upon what is comparatively easy to grasp. If mind-atoms differ only in size or shape or mobility from other atoms, if they have their location in space, it is easy to conceive how they may be jarred into new motions by the impact of atoms cast off by surrounding objects. There is nothing hopelessly mysterious in the clash of material particles; we see something of the kind going on about us on a larger scale all the time. But if we are to be content with this view of the process of knowing, we must pass lightly over the very significant statement that "thus arises the knowledge of external things." Nothing exists save atoms and void space; under which of these heads shall we subsume this 'knowledge'? or shall we, perhaps, make it identical with the motions of the atoms through the space? And if we drop the notion of mind-atoms, and confine ourselves to the study of nervous processes and those physical events in which they have their inception and in which they terminate, the case is the same. What becomes of those phenomena with which the psychologist supposes himself to be dealing? What becomes of sensations, memories, thought-processes? A whole world of things seems to be left wholly out of account, ignored as though it were non-existent. Shall we outrage common sense by insisting that these are but another name for the nervous processes themselves, and hence do not require independent investigation?

The absurdity of such a position can best be made clear by the use of an illustration. Let us suppose the boy, whose motions have been discussed in the preceding paper, to be about to begin his attack upon the dog. As we have seen, boy and dog are certain collocations of material particles in certain space relations to each other and to the rest of the material world. They are part of the mechanical system of things. Every motion of every particle is foreordained by the law

of the whole, and could be foretold by one sufficiently well informed and sufficiently wise. To us, the spectators of the drama, the actors do not seem to be such swarms of minute elements, but Democritus could inform us that this is because our senses are too weak to see them as they are. Suppose that by some miracle this hindrance were removed, and that boy and dog stood revealed to us in their atomistic nudity—infinitely complex, discontinuous, each a universe in which system could be traced within system, all developing their countless series of changes in harmony with mechanical laws. Could we see all this as it would be open to the eye of omniscience, the task of science, in so far as it is merely physical science, would be satisfactorily completed. Every change in every particle of matter, and, hence in every collocation of particles, would be accounted for. We should know perfectly why the boy hits the dog, and why the dog runs though his series of twistings and turnings. Puffed up with such knowledge we might feel inclined to despise the blind antipathy to Dr. Fell that remains incapable of justifying its existence by a reference to mechanical causes.

But while we are thus gazing upon the intimate structure of the boy and the dog, we become conscious of the fact that the closest acquaintance with the machine does not bring within our view certain things that we might have expected to find there. The boy sees the dog, and sees him to be yellow. He hears him bark. What are these sensations of color and sound? What have they to do with the mechanism? They are certainly not a part of it in any intelligible sense of the word. The machine and all its workings can be perfectly well understood without referring to them at all. To our discriminating eye the vibrations in the luminiferous ether and the vibrations in that grosser medium, the air, lie open and are numbered. The mechanical changes, the translocations of atoms, which take place in the organ of sense—changes which an observer endowed with a vision less acute could only subsume under such concepts as chemical or 'vital'—stand forth stripped of their mystery. The subsequent changes in the sensory nerves, the rearrangement of atoms and molecules in the central nervous system, the changes

in the motor nerves and in the muscles, all these we follow step by step. The chain of mechanical causation is unbroken, and it is nowhere necessary to turn aside from the straight path upon which we are journeying. Nowhere do we find color or sound, or anything resembling color or sound. The more clearly one realizes just what is meant by the world as mechanism, the more clearly does one see that it is a world which has in it no room for a vast number of things which are plainly to be found in our experience, and the existence of which can only be overlooked by one blinded by prepossession in favor of some philosophical theory.

Upon the crudely unreflective materialism which rather startled the world with the emphasis of its unmeaning utterances half a century ago it is scarcely necessary to comment to-day. The much discussed statement that the brain secretes thought as the liver secretes bile needs no labored refutation. To such vision as we are supposing ourselves to possess, the mechanical structure and functioning of each organ would be plainly evident. The secreting organ and the secretion would in each case be perceived to be such and such collocations of matter, having an unequivocal existence in the material world of things, and no single atom or molecule in either would lack its definite place in the mechanism of the universe. The globule of saliva is as much a part of the material world as is the salivary gland. The atoms which compose it have an existence as independent as the atoms which compose any other group, and they are equally indestructible. Their relations to the atoms in every other group are spatial, and all changes in these relations may be described as motions in space. The gland and the secretion may be separated and set at a distance from each other; this does not affect the existence of the secretion. The gland may be destroyed, that is, the collocation of material particles which passes by that name may be made to undergo great change; nevertheless the secretion may remain unaffected. The relative independence of gland and secretion, and the unmistakably material nature of the latter are thrust unpleasantly upon our attention by the numberless threats and admonitions which the constituted authorities in civilized countries have found

it necessary to affix to the walls of waiting-rooms in railway stations, to hang up in trains, and to bring to our notice in divers other places. The ill-bred fellow who has been lounging in the corner of the railway-carriage, takes his salivary glands with him when he steps out of it; but he leaves behind an unwelcome reminder of his former presence, which persists in its independent being and asserts its right to a place in the world of matter. Can any thoughtful man seriously maintain that the color seen and the sound heard are related to the brain of the boy, who sees the dog, in any way analogous to this? The man who sat in the corner might have occupied himself during his whole journey with thoughts of wholesale massacre; he might have called before his imagination the most hideous combinations of colors; he might have hummed over in his mind the most unmelodious of tunes; yet, on his exit, the place might have been taken contentedly by a timid man with artistic tastes. Of such things as these no trace remains, and no one expects to find a trace. Sounds, colors, and a whole world of other things that we may classify with these, are not collocations of matter which exist in space side by side with certain other collocations of matter which we call bodily organs. It is only mental confusion that can identify them with such.

Perhaps some one will be tempted to point out once more that the functioning of the brain does result in certain material products which can be traced by the physiologist. There is a destruction of tissue which must be made good by reconstruction. This is, of course, true. When the brain functions, there are waste products which pass into the blood and are ultimately eliminated from the body by other organs. But it should be noted that such products, when they are discovered, are not found to be in the least like those things which we have been discussing. They are not colors, they are not sounds, they are not memories of such. They are not to be identified with any of those things of which the man was conscious while his brain was functioning. The elements which compose them formed part of the man's body; they were jostled out of the combinations in which they stood; they were finally excreted. Of their existence during the whole process he has not had the faintest

suspicion. For identifying them with the things of which he was conscious at the time there seems to be no excuse.

Thus this vain talk of 'secretions' may be unhesitatingly set aside when we are considering such things as the color of the dog as seen by the boy, or the sound of his bark as heard. Even the Democritean slurring over of the existence of sensations and that of reason which can alone discern the truth about the atoms and their motions seems preferable to such gross misconception. Democritus recognized the existence of these things, but failed to find for them a place in his scheme of existence. The secretionist gives them a place in the system of things, but they cannot take that place without ceasing to be what they are. He denies them their own proper nature and confounds them with something else.

It may be thought that it is an excess of zeal to spend even so much time as I have done in the criticism of this form of the materialistic doctrine. Why sally out in chase of the dodo, when that bird has disappeared from the face of the earth? To this one may answer that *this* bird has not wholly disappeared, but that specimens may still occasionally be met with in out-of-the-way corners. My own experience has been that they are more apt to be found in the medical profession than elsewhere, perhaps because that profession embraces a vast number of men who have some acquaintance with physiology and psychology, but only a limited number of whom can be legitimately expected to be possessed of philosophical acumen and to be thoroughly equipped with accurate information upon matters physiological and psychological. And one may answer, in the second place, that the secretionist's misconception is but one of a type, and it may serve to throw light upon a whole group of errors to analyze the most striking instance to be found in the group. A more insidious form of the misconception is often made to lurk in the statement that what is somewhat loosely called thought is a 'function' or 'activity' of the brain, a statement which may seem not unsatisfactory to one who is ready to turn a deaf ear to all mention of secretions. One is reminded here of the old Greek notion of the soul as a harmony of the body, which notion, as readers of Plato will remember, was some-

times taken with serious literalness and supposed to be fraught with grave significance.

But it is never wise to use a phrase without at least an attempt to determine with some accuracy what it really means. What are 'functions' or 'activities' of the brain? To such vision as we are supposing ourselves to possess, it is quite clear what the brain is. The dullness of our sense has been done away, and we see, as with the Democritean Reason, an army of atoms going through its evolutions with mechanical precision. It is not a mob, a mere rabble. We can trace in its infinite complexity relatively permanent groupings in the midst of incessant changes. Formation succeeds formation; the individual units group themselves, divide, scatter, and re-form into new groups. A patient observation of what takes place, and a comprehension of the mechanical laws which govern the actions of each, enable us to predict what groupings will appear upon the scene when the present arrangement has filled its moment and dropped into the nothingness of things past. These motions in matter, these groupings and regroupings of atoms, these are the functions or activities of the brain, in an unequivocal sense of the words. They are the only ones that display themselves before our eyes, and, as we have seen in the preceding paper, they are the only ones needed by science to explain the whole series of positions taken, in the material world, by the body with which this brain is connected — in the instance above mentioned, the wild chase of the dog, the shouts of laughter, the wavings of the stick. Shall we say that the color seen and the sound heard are also functions of the brain? And in this case shall we regard them as distinct and separate functions of a quite different kind, or shall we assume that they are identical with some of the motions which we see before us? Shall we say that this particular clash of atoms is the color yellow, and that one is a sound? If we assert that such as these are functions of a quite different kind from motions, we seem to be stretching a familiar word to the point of breaking. We ought to recognize that, when we call things quite different by the same name, we are not justified in putting them into the same class, and in assuming that the one has been assigned its

place in nature when the other has. On the other hand, if we maintain that colors and sounds are identical with certain atomic motions, we seem to be talking nonsense. The atomic motions we can see plainly before us. As well call a triangle an emotion of grief as call this particular clash of atoms yellow. The atoms are not yellow and their motions certainly are not. If it is an error to confound a color or a sound with a material secretion, it is surely no less of an error to confound them with motions in matter.

As a matter of fact even those who elect to speak of thought as a function of the brain, do not exactly identify colors and sounds as seen and heard with motions in the constituents of the brain. They do not conceive those motions to be colored or resonant. They accept their own phrase loosely, and when cross-questioned usually have something to say about double-faced entities, the outside and the inside of things, etc. With these modifications of their doctrine we are not here concerned; what concerns us is the fact that any doctrine which maintains that science has to do only with matter in motion removes from the province of science many things which common sense and common experience insist upon as really existing. If science is to be thus circumscribed, then scientific knowledge carried to its extremest limit must wholly ignore much that we find in our experience, so much, indeed, that, were it dropped out altogether, we should not recognize our experience as our experience at all.

The more clearly one recognizes, therefore, just what is meant by the mechanism of nature, the more clearly one sees that there is no room in it for such things as color and sound as seen and heard. This world of mechanism is, indeed, the world of the primary qualities of matter dwelt upon by John Locke in his 'Essay.' From it all those elements of our experience which are sometimes loosely called the secondary qualities of matter are to be carefully excluded. Colors, sounds, odors, etc., are not, as Locke expressly states, qualities of matter at all, and he insists that they do not resemble them. That something in matter must correspond to them, he regards as self-evident, and this something he calls the secondary qualities of

matter. But he defines these secondary qualities as powers which objects possess of arousing sensations in us by means of their primary qualities. Thus, in the world of matter, there is no real distinction between primary qualities and secondary. The secondary are seen to be nothing other than the primary—they are configurations of, or motions in, matter; these particular motions which we connect with, and too often confound with, the hearing of sounds or the seeing of colors. That such configurations and motions should not be confused with the sounds heard or the colors seen Locke saw clearly. He made the latter effects of the former, but he had better sense than to suppose the two classes of things to be identical.[1]

The modern man, who has had the advantage of reading what men have written since touching the nature of our conception of matter, ought to be in still less danger of falling into such confusions. The world of matter and motion is a world given in terms of touch and movement sensations. It is a vast system built up out of elements which have been selected from our experience as a whole, but which by no means exhaust its rich diversity. It is a mere skeleton, a framework and nothing more. When it is recognized what the material world is in its ultimate constituents—I speak psychologically and not physically—it is impossible to think that nothing exists save matter and motion. This is seen to be tantamount to the assertion that color sensations are identical with sensations of quite another class, which is palpably absurd.[2] To regard as identical classes of experiences which are evidently dissimilar is inexcusable, and to dismiss as non-existent all classes of sensations except those which fit into a particular series, arbitrarily narrows the meaning of the word existence to a special use. Both in science and in common life we constantly speak of colors, sounds, and odors. We mean something when we do so. To declare such things to be non-existent is palpably contrary to common sense and to the accepted usages of speech.

[1] Book II., Chapter VIII.

[2] If anyone chooses to distinguish between the material world 'as given in terms of touch and movement sensation' and the real material world as it is, distinct from all sensation, it does not affect the question. It only emphasizes the absurdity of overlooking the existence of the 'subjective.'

Thus we see that it is impossible for reflection to rest content with the Democritean world of atoms and void space, and ask no questions touching those other things which Democritus recognizes but to which he explicitly denies a place in the system of things. It is impossible to be satisfied with a mechanical theory of the universe, however carefully elaborated by modern science, which simply ignores a large part of our experience, and regards its task as completed when it has reduced to order the remainder. One is constantly reminded that something remains to be explained. In common life we hear little of the atomic structure of things, and much of the color, the odor, the taste, of the apple or the peach. We speak of our wine as white or red, as sweet or sour. A bruised finger aches, and all notion of mechanism is driven from our thought by its maddening pulsation. These things stand in the foreground of our experience; to overlook them seems absurd. To think of the world as composed exclusively of atoms in motion, one must banish the world, sit quietly in the dim light of one's study, glue one's eyes to the paper, and write oneself gradually into a frame of mind in which the abstractions of mechanics seem the only realities. The first tap at the door, the first note of the finch in the tree outside, may easily remind one that the world is really painted in colors, and is not a monotony of black and white.

It is the same when one talks with men of science, or reads an account of their experiments. We watch the chemist pour one colorless liquid into another. He has told us that the 'resulting color' will be this or that, and his prediction seems to have been justified. The physiologist gives us a brief sketch of the anatomy of the eye and of the ear. He traces as well as he can their connections with the various parts of the brain. He then launches out into a far more extended discussion of sensations of color and sound—not brain-changes, but sensations of color and sound—as though such things really existed, were worthy of being discussed at prodigious length, and were not so cut off from molecular changes in the substance of the brain as to make it impossible to pass from the one to the other. As for the psychologist, whatever may be his enthusiasm for mechan-

ism, and however closely he may ally himself to the student of physical science, he simply cannot speak at all without reminding us that there are other things in heaven and earth than motions in matter, than the clash of the Democritean atoms. If we expunge from his pages all reference to what does not form part of the mechanism we have been discussing, we leave most of them as white as when they went into the hands of the printer. Even the headings of the chapters are gone, and the title of the volume has become an empty sound. There remain some descriptions of apparatus, and an outline of the anatomy and physiology of the nervous system, the latter a mere shadow of its usual self as we find it set forth in the works of the physiologists.

Very likely it will be objected that this devastation which is wrought in the sciences by insisting that they shall omit all reference to what cannot take its place in the world of matter and motion, has its origin in the fact that the sciences are as yet so imperfect. A science which does not know the actual changes which are taking place in the mechanism of the universe, must, if it is to talk at all, be allowed to talk about something else. Yet he who thus speaks may be conscious of the fact that, did he know more, he might speak in quite another way. The pouring of one liquid into another is a mechanical change. The chemical combinations which result may also be regarded as mechanical changes. Such changes, which, of course, do not lie open to direct inspection, may be assigned their place in the cosmic series of causes and effects. One may speak of the 'resulting color' without seriously intending to maintain that the color seen has its place in the series. It may be taken as merely representative of what has such a place, as a convenient handle by which to take up an occurrence which cannot readily be laid hold of in some better way. It is permissible to refer to 'Monsieur Chose' when we do not know the man's real name. Similarly, our desolating ignorance of the intimate structure of the brain and of the changes which take place in it, may force the physiologist and the psychologist to talk of colors, sounds, odors, tastes, pleasures, pains, memory-images, concepts, and what not: but if they knew more of the

mechanism of the human body, could they not describe all its activities without any reference to such things as these at all? Were science more advanced, could there not be a physiology, and even a psychology, that made no reference to such? Could not these sciences study man as a mechanism, and content themselves with the knowledge of all that this mechanism could possibly do? Certainly, if the mechanical view of the material universe is a true one, it is not permissible to follow the chain of mechanical causes a little way, abandon it at a certain point, and then return to it again, except as a last resort and a temporary expedient. One may deplore this expedient even while availing oneself of it.

To the objection that the chain of mechanical causes and effects could, at a more advanced stage of science, be rendered more evidently complete, one need not care to bring an answer. I have merely wished to point out the fact that, in the present state of the sciences, it is inexcusable to overlook the existence of all save the Democritean atoms and their motions, since that existence is forced upon one's attention at every turn. Nor is it without significance that it is possible, when we find the series of mechanical causes broken by our ignorance, to piece out its deficiencies by turning to something else. Certain things cannot be made to stand as representatives of certain others unless there be some true relation between the two classes.

The importance of this relation is sufficiently evident, for it is possible for the plain man to interpolate into his series of mechanical causes such things as sensations, and yet to infer with a good deal of accuracy what occurrences will or will not find a place in the world of his experiences. It seems to him madness to deny that sensations and volitions can be the results and the causes of changes in the material world. The puncture caused by the mosquito gives rise to the sensation of itching, and this sensation leads to his scratching the spot attacked. The fall of the apple from the tree causes in him certain visual sensations, and these visual sensations are the cause of his desiring to possess the apple, which desire sets his body in motion and leads to the appropriation of the fruit. The descent of the

hammer wounds his finger; this causes pain; the pain causes facial contortion and the insertion of the wounded member into his mouth. The fact that such chains of antecedents and consequents do present themselves within his experience, no man can with justice deny. He assumes them to be a series of causes and effects, and he regards it as unnecessary to isolate and set apart the merely material, even if the thought of doing so ever crosses his mind.

The man of science is apt to speak with rather more hesitation, even when he makes no deliberate attempt to view things with the eye of the philosopher. The chemist may talk of a 'resultant color,' and may even admit frankly that he thinks of color as an effect of physical causes, but we do not find him ready to admit that color can in any true sense be a cause of physical changes. The physiologist tells us that a common effect of the arrival at the central nervous system of impulses passing along afferent nerves is a change in consciousness, or a sensation.[1] He also tells us that choice may be determined in some cases by intelligence,[2] and that in an ordinary voluntary movement an intelligent consciousness is an essential element.[3] He assures us, on the other hand, that, looking at the matter from a purely physiological point of view, "the real difference between an automatic act and a voluntary act is that the chain of physiological events between the act and its physiological cause is in the one case short and simple, in the other long and complex."[4] Psychologists divide themselves into classes, the one class falling in with the opinion of the plain man and the other regarding the series of mechanical causes as unbroken. One cannot claim the authority of psychologists as a class for either doctrine. Finally, the logician tells us that it is the great aim of science to trace the relations of cause and effect which obtain in nature, but we remark the fact that he does not hesitate to illustrate the inductive methods of scientific research by a description of investigations into the 'causes' of the iridescent colors on mother-of-pearl, or on thin plates and films.[5] We

[1] Foster, 'Physiology,' 6th ed., III., pp. 850, 851.
[2] *Ibid.*, p. 909.
[3] *Ibid.*, p. 1068.
[4] *Ibid.*, p. 1004.
[5] Jevons, 'The Principles of Science,' Chapter XIX., § 2.

ask at once, does the logician mean to maintain that colors have their place in the natural order of causes and effects? Can they be the result of mechanical causes? Logicians speak as though they could, and they treat them accordingly.

Of course, the adherent of the doctrine that the material world is a perfect mechanism will regard those whom I have above cited as in need of enlightenment. He will maintain that the opinions of the plain man must not be uncritically accepted as true; and will point out that one may be a pretty good chemist, physiologist, psychologist or logician, without on that account being much of a philosopher. He will, moreover, call attention to the fact that, in special investigations of all sorts, it is permissible to use language in a way which is not strictly correct, provided that such a use of words serves our convenience and does not give rise to unavoidable misconception; and he will remind us that one may reason well without being fully conscious of the true significance of the terms employed in one's reasonings. Those who enjoy the clearest vision, he will insist, and who best understand the course of the development which science is undergoing, will be in the least danger of falling into the error of supposing that the cosmic mechanism really needs to be patched with such unsubstantial stuff as colors or odors, pleasures, pains or memory-images.

But when he has said all this, he ought to frankly admit the significance of the fact, that such wide-spread error may exist without either in common life or in science revealing itself to be error by undeniably undisastrous consequences. This can only mean that those things which he has set aside as finding no place in the cosmic mechanism are, after all, intimately related to that mechanism. Where our knowledge of the mechanism is defective, it may be more or less satisfactorily pieced out by their aid, as we have seen. And it is quite clear that were our knowledge of the world of matter and motion so complete as to make it quite unnecessary to borrow such patches, this would not in the least imply that the world of sounds, colors, tastes, odors, and all the rest, would cease to exist and to be related to the world of matter and motion. In certain special investigations it would, it is true, be unnecessary to refer to such things,

whereas this reference is at present unavoidable. But to limit the sphere of science to such investigations seems absurd. It is surely not the whole duty of man to fix his attention upon the ordering of sensations of touch and movement into a satisfactory mechanical system, to the complete neglect of experiences of every other sort. That these other experiences do not defy all attempts at arrangement is sufficiently clear from what has been said above. It seems, then, as though it ought to be the task of science, in the broad sense of that word, to reduce the whole of our experience, and not merely a part of it, to some sort of system. Anything less results in the mutilation, not the explanation, of the world in which we live.

But how attain to such a view of the whole of our experiences as an interrelated system? Surely one may sympathize with the Democritean, and admit that he is driven to his position by encountering what seems a very real difficulty. Once admit that the material world is a perfect mechanism, and there appears to be no bridge by which one can pass from it to another world and back again. To the plain man the difficulty does not exist, for his real world is a composite thing in which material and non-material elements are patched together to form what cannot exactly be called a mechanism, and yet resembles one in spots. To the nature of the connections between its different and discrepant elements he has given little thought; that they are somehow connected is enough for him. But he who desires to think clearly can scarcely rest content with a conception which seems to remain satisfactory only so long as it remains vague and obscure. He asks how he is to conceive this connection of the material and the non-material, and what is meant by their interaction. The more he thinks about the thing, the more it seems to him impossible that motions in matter should have as their causes anything save motions in matter. And yet, if this be so, what shall one do with colors, sounds, odors, and the rest? What shall one do with the subjective, with *mind*? Has it a place in the system of things, or has it not? As the 'system of things' is pretty sure to mean, to one who has busied one's self chiefly with physical science, the cosmic mechanism, an exclusion from the latter may seem almost tantamount to a denial of existence.

Such a denial is manifestly mystifiable, and can scarcely be made by a man with open eyes; but one may glide over the subject lightly, as the atomists appear to have done, and discourse chiefly of the material. Or one may half face the question, and justify one's exclusive occupation with the material by the assertion that thought is a bodily secretion, an assertion which we have seen to be a foolish one, and one which testifies rather to a man's respect for the mechanical order of things than to his powers of reflection. Finally, one may regard mental phenomena as 'inside' of molecular change, or call matter a 'double-faced' entity, thus seeming to connect things of divers kinds which do not seem capable of being built strictly speaking into the one system. Just how much one may mean to say, when one uses such expressions, must depend upon one's clearness of vision. They may only indicate a vague recognition of the existence of the world ignored by the Democritean, coupled with the desire to incorporate it somewhat equivocally in the world of matter in motion. They may, on the other hand, mean more, and they deserve careful analysis. But the mere fact that one is tempted to use them is a sufficient indication of a recognition of the futility of attempting to limit the sphere of science to a description of the changes which take place in the material universe. It is an admission that something exists save matter and motion, and a doctrine that makes this admission has advanced beyond the standpoint of pure materialism. It may, it is true, remain materialistic in feeling, and the amount of attention it bestows upon the subjective elements of experience may be quite inadequate. Still, it should be given credit for a truth which it sees but dimly. If it sees it at all, it cannot conscientiously object to the most strenuous efforts to throw light upon this dark corner in human knowledge. It cannot, in other words, frown upon the labors of the metaphysician, unless this worthy makes it quite plain that he assumes his premises without proper precautions, uses words and phrases without having carefully looked into their significance, draws conclusions without clearly recognizing what constitutes proof, or does any of those things that have so frequently made the word metaphysician stink in the nostrils of the prudent and the practical man.

His task is not an imaginary one. It is set for him by the nature of our experience. Even Democritus unconsciously incites him to set about its accomplishment, in that he delivers into his hands certain things which unquestionably exist, in some sense of that word, and yet for which no place is provided in the world of existing things.

DISCUSSION AND REPORTS.

PROFESSOR FULLERTON ON 'THE DOCTRINE OF SPACE AND TIME.'

In a series of articles published last year in the *Philosophical Review* Professor Fullerton has discussed in an interesting way the doctrine of space and time. His articles bear the following titles: I. The Kantian Doctrine of Space; II. Difficulties Connected with the Kantian Doctrine of Space; III. The Berkeleian Doctrine of Space; IV. Of Time; V. The Real World in Space and Time; and with regard to the terms Kantian and Berkeleian we are promptly told that these are used 'in rather a broad sense to indicate types of doctrines,' there being no intention 'to make either Kant or Berkeley responsible for later additions to or alterations in the structure which he reared upon the foundations that he himself laid down.' As might be inferred from the titles, Professor Fullerton's object is to adapt the two opposed views to each other, but as it turns out with a strong preference for the Berkeleian. Thus (p. 385):

> "Surely the Berkeleian doctrine is preferable to the Kantian and should replace it. But it is desirable not to overlook the fact that the latter doctrine emphasizes a very important truth—it insists strenuously upon the validity of the application of mathematical reasoning to phenomena. In this it is wholly in the right, for here it is recognizing the system of relations which obtains within our experience as a whole. Its only error—that is, its only fundamental error—lies in supposing that in dealing with any single intuition it is dealing with 'real' space and 'real' things. If the Berkeleian will admit that 'real' space is infinitely divisible (as it may be), and if the Kantian will admit that 'real' space is not given in any intuition (as it certainly is not), there need be no quarrel between them."

And what is said of space *mutatis mutandis* is said in substance also of time, so that in the foregoing quotation, which is at once a summary of Professor Fullerton's criticism and the foundation of his subsequent construction, we have—if the metaphor is not too sanguinary—an excellent base for the operations of the present review. But before mobilizing our forces it will clear the ground a little to say that there seems to have been no real need of the *finesse* about those terms used 'in rather a broad sense.' The Kantianism and the Berkeleianism that are discussed seem peculiarly free from anything like neo-ism.

Now, for our first move, Professor Fullerton's study, in so far as a comparative study, is open to the same objections that would be urged properly enough against partial or garbled quotations or against the abstract comparative study of the corresponding members of any two creatures in the animal world. Animals are living wholes and to abstract certain parts for comparison may afford a useful exercise, say in anatomical investigation, but it can have only the value of exercise or at least it cannot have the value of fundamental comparison. Moreover the objections involved here are, if there is any difference, more pertinent in the case of Kant's and Berkeley's philosophies than in that of anatomical study, for the criticism of these men is certainly very far from the exercise stage. Am I reminded that there are nevertheless real defects especially in Kant's doctrine of space and time? Then I must insist (1) that Kant's philosophy is a living whole both in the matter of the relation of its many parts and in the matter of its own development and (2) that even in the event of conspicuous error in any part a good deal is to be said for the notion of any thoughtful philosophy—such as Kant's!—being a system and if a system also a system which in some way direct or indirect itself compensates for its own errors. On both of these counts, then, the vital wholeness and the inner compensations, I find reason for qualifying the value of Professor Fullerton's study. Can his criticism afford even to seem unconscious of either of them?

But, secondly, if so far I may be accused of being hypercritical, making such labors as Professor Fullerton's too complicated and too arduous even for the present day, with the following suggestion no one can find fault. Any up-to-date study of space and time, even of Kant's and Berkeley's space and time, or of the 'real' world in space and time, can not afford to be made in any light but the best which the current information of the sciences, especially of mathematics, is capable of supplying. In the articles before us, however, one finds little if any sense of the message that the newer mathematics, to say nothing of some other sources of information, brings to the question at issue. Of course it is always easier to detect than to supply a defect, and I would make no pretenses myself to being up-to-date mathematically, but for present purposes it is enough that in a doctrine of space and time one should at least try to be. Questions of infinity, of infinite divisibility and the like which Professor Fullerton properly enough and perhaps conventionally enough treats as of paramount importance in his undertaking are if not directly at least indirectly questions of mathematics, and the implied if not the open solution of them in

mathematics can not but affect—in a way that I, having caught some of the rumors of the day, shall try to indicate—those other questions, also considered by Professor Fullerton, of 'real' space and time being intuitions or not or of the really intuited space and time being only symbolic.

Thus Professor Fullerton very early in his discussions runs against the old-time paradoxes of divisibility and infinity and he certainly says some excellent things about them. In italics, for example, that are his own he declares (p. 237) that '*the whole nonsensical edifice*' which the paradoxes and the traditional uses of them, including the Kantian, have made—'*rests upon the one nonsensical assumption that an endless series can be completed by a progress which results in the attainment of a final term.*' This is certainly true or an important part of what is true, but within only a page or two Professor Fullerton betrays what is at least one of its logical consequences in that he misses the real import of infinity by recognizing the possibility of infinite divisibility and accusing of mere quibbling those who would distinguish between being *infinitely divisible* and *infinitely divided.* What can the absence of that final term, supposed to end the endless series really mean if not that infinity is not a quantity at all, that the infinitely small part is a contradiction of terms and that accordingly infinite divisibility must refer, if there be any meaning however hidden or indirect in it, to something besides physical or quantitative composition. Being *infinitely divided* is a conception of status and is obviously impossible, while *infinite divisibility* is neither static nor quantitative. Infinity is a door by which both quantity and division or composition enter into a new world and become transfigured.

Parallel lines on a plane surface meet at infinity just because they are parallel, the meeting at infinity being really significant of their quality or relation—the parallelism, not of their length. Two such lines of only an inch 'meet at infinity' even within the inch in having a *common* straightness, the infinity being only an indirection for the relation. Circles in the same plane have parallel circumferences and they all meet at infinity in the same way.

The series constructed from the results of a continued bisection, 1, ½, ¼, ⅛ . . . etc., is completed only at infinity and has a determinable sum, not because it has a final term, but on the contrary because, as Professor Fullerton himself insists, there is no final term. Yet this is very far from meaning infinite division as a status or possible status; it means only that infinity is an indirection for the constant relation of bisection, that even with the first division and the consequent derivation

of the second term all that the infinity itself stands for has been expressed. The infinitely small or great taken quantitatively is only symbolic of a uniform process, of an activity under a fixed law, of a principle immanent in every term of the series and giving to the series as a whole a unity that quite transcends the limitations of quantitative division.

Professor Fullerton's disc (p. 238) affords still another case. It completes one revolution in half a second, the next in a quarter of a second, etc., etc., and at last develops an infinite speed, which means or seems to mean no time at all for a revolution and is accordingly equivalent to rest. But the infinity means only the uniform acceleration, there being in it, not the rest of a final term, but the rest of the uniformity which dwells within the process itself and so belongs to all the terms. In short, in this case as in the other cases, infinity stands as an indirect but not less effective way of asserting the constructive principle of a series and so also of symbolically presenting in a quasi-static form the dynamic character that the series contains or even more generally the quality of any number-group. The infinity is immanent in every one of the numbers or every one of the terms.

In the history of mathematics did not application of the idea of infinity eventually turn quantity from mass to ratio? But in the ratio quantity somehow becomes independent of the differences of mere magnitude. The ratio is a law, not a mere sum. With the ratio, however, in course of time there came and there had to come into mathematics the equation—really another gift of infinity. The equation is only the full expression of the law. At infinity, once more, that is, in an infinitely divided space, the flying arrow rests, Achilles runs hopelessly, and that disc stops, but in each case emphatically the rest is no mere negative of extensive, distance-covering motion; it is instead the constancy of some relationship, as if the intension of motion. In a world of quantity as mass motion is motion, but it is rest in a world of quantity as ratio and being rest there it has been open to mathematical treatment through the equation and the calculus that has the equation and infinity for its corner stone.

So those old-time paradoxes and the nonsensical edifice for which they are responsible rest upon something more than merely the nonsensical assumption of a final term. They are equally and perhaps more significantly—although I should not draw invidious distinctions—due to blindness to the import of infinity. The real last term at infinity is not indeed one more among all the other terms and co-ordinate with them; rather it is the abstracted principle, say the sheer

parallelism or the bare fact of bisection—without anything to be bisected, or the simple constancy of acceleration or the mere persistent ratio of Achilles' to the tortoise's speed, that sets or establishes the series, and in the light of the history of mathematics this is but to say that the paradoxes and their edifice are consequent upon nothing more or less than the two meanings of quantity which infinity bridges—quantity as mass and quantity as ratio, the one static and the other dynamic. Duplicity always makes paradoxes and if blind it makes nonsensical paradoxes.

But now what of Professor Fullerton's distinction between 'real' space and time, which are infinitely divisible and are not intuitions but constructs or conceptions, being 'the plan or system of [the real world's] actual and theoretically possible relations and changes' (p. 598), and intuited space and time, which are not infinitely divisible and are only symbolic? "The world as it lies before me," says Professor Fullerton, "is * * * not a thing directly given in intuition, even if I stop at the world of common knowledge, and refuse to follow the scientist into the unseen region in which atoms and molecules disport themselves in a space infinitely divisible. What is intuitively present in consciousness is not enough to constitute such a world. It can only represent it. It is, indeed, the *symbol*, and the world is the thing symbolized. * * * We *think* [the world], that is to say, there is intuitively present in conciousness that which represents it, but that is all we can say" (p. 587). To say to Professor Fullerton that his distinction breaks down would not be quite fair or true, for if we grant the general standpoint of Kant and grant accordingly that the only pertinent questions are 'questions of fact' as to what is intuited and what is not intuited but conceived in our space and time experience, then among the answers of Kant and Berkeley and Fullerton, who are all on the whole under the same spell, the answer of the last is decidedly the most satisfactory and is well supported by the author himself. But the form of thought, the general standpoint, not the pigeon-holing of the material, is what needs important if not radical revision and the material meanwhile may be left to take care of itself. To touch upon nothing but that of which Professor Fullerton himself makes so much in his argument, the question of infinity and divisibility is solved by him in a way that in the first place is *formally* Kantian and that in the second place, as has been shown here, at least seems to be wholly blind to the double meaning of quantity. Accordingly, his eyes being thus darkened he is able to dream as he does and along with his other contentions to say what he certainly does say so well (p.

589 sq.) of possible void spaces and times, but the duplicity, when recognized, changes the whole view as if by projecting it upon an entirely different plane. Massiveness—mere finiteness—is not the only truth of quantity; instead, if taken alone it is really an untruth; but relationship or ratio—infinity—is another and a fulfilling truth of quantity. All quantity is *both* mass and ratio and is one of these in being the other, not one *and* the other. The world, then, of intuition can hardly be a world intuited only in a finite space and time and serving as a *symbol* of reality in an infinite and infinitely divisible space and time. The intuited symbol must itself be in and of the reality, however infinite and impossible to consciousness—of course a formal, static consciousness—this may seem to be; or, in other words, intuition, like its quantitative forms, must have a dynamic character, and in this character alone, not in any other basis of generalization, can its so-called symbolism lie, while through this it includes, not is merely accompanied or followed by the activity, the immanent activity of thought. Are the *given* forms only symbols of life to the morphologist? Or of force to the physicist? Or even of religion to the real worshipper?

In recent mathematics we have a development that is not without its special significance here. Mathematics has been making wonderful excursions apparently away from this world of space and time altogether into other worlds, strange and unrecognizable, the worlds in general of other dimensions than those with which in our positive intuitive consciousness we have any familiarity. And what can such excursions mean? Hardly a reality of which this world is symbolic, for those other worlds are no mere extension of certain fixed, statically intuited forms of this. They are worlds, not of mere distances and magnitudes, however great or small, but of altogether non-spatial and even non-temporal rational orders; they are worlds of specific arrangements; they are systems, their dimensions being only so many functionally related variables. And so, unless—as is not impossible—my ears have heard the rumors falsely, they are after all actually in and of this world of our positive consciousness. I would even be so bold as to say that infinity by involving if not clearly revealing the principle of ratio or relationship in the world of quantity had been at least the outer door through which mathematics had entered these new worlds. Yet is this new mathematics 'applicable to phenomena'? It has done more or bids fair to do more for the cause of application than whole cycles of tridimensional formulæ, and its applicability must be taken as conclusive evidence of the relation between intuition and thought, symbol and symbolized, being far more intimate than even Professor Fullerton seems ready to admit.

But, in conclusion, for some of the things that I have said I may be classed with those whom Professor Fullerton accuses of 'bringing metaphysics into disrepute with men of scientific mind' (p. 598). I can only say that the rather long-standing fear, so mutual and so cordial, between science and metaphysics seems to me humorous 'to a degree'—forgive the lapse. There are times when boys stand up before each other and talk abusively and boastingly but safely keep their distance, and science and metaphysics have been very like them. But for my part, whatever the consequences, I believe that more courage from both might accomplish some good things. There is only one reality. Why two independent studies of it? The scientific mind is, indeed, a noble thing, but truly mind is a nobler.

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ON THE 'FATIGUE' OF NERVE CENTERS.

In a brief but interesting article in *The New York University Bulletin of the Medical Sciences* of July, 1901 (Vol. I., No. 3), Dr. R. S. Woodworth maintains that, contrary to the rather common opinion, the nerve-centers controlling voluntary muscular movements are not more easily 'fatigued' than are the muscles connected with them—and this seems to be very slowly indeed. From both the physiologic and terminologic points of view this contention seems open to some criticism of a doubting sort.

The author bases his opinion in this matter on four portions of evidence which may be summarized as follows: (1) "The fatigue of voluntary muscular contraction is very much slower in developing than Mosso's [well-known] curve would indicate. * * * I have myself made a series of over 1,300 maximal contractions lasting in all for three-quarters of an hour, with a loss of but 10 per cent. of the original force." If the whole motor apparatus concerned in these movements shows this great endurance, surely, thinks the author, the nerve centers involved cannot be as easily fatigued as Mosso and many followers suppose. (2) Experiments were made intended to compare the fatigue curves produced by the muscles alone and those made in cases where the motor nerve centers also were employed. Simultaneous records from a frog's two gastrocnemii muscles were made, one being electrically stimulated directly and the other electrically stimulated through the medulla or else through a sensory nerve. "I was surprised to find no perceptible difference in the rate of fatigue" by these two opposed methods. Similarly, experiments made on the human subject (by

comparing curves made by stimulating the muscles directly with those made by muscles voluntarily innervated), 'gave sensibly the same rate of fatigue.' From these two sets of experiments the conclusion was suggested that 'the fatigue of the nerve centers was practically *nil*,' within the limits of the experiment. (3) In those experiments which 'call for the closest attention and most exact coördination, but not for great muscular effort,' there is opportunity for the studying of fatigue of nerve centers free from the complication of muscular fatigue. For example, when a person hits a dot target on a table before him with a lead pencil the movement can be repeated 12,000 times with a loss of only 13 per cent. of the original accuracy. In correcting examination papers even six hours at a time, the degree of fatigue was small compared with what one would expect. "In this sort of experiment, as well as in voluntary muscular work, there is an abundance of *feeling* of fatigue; but the feeling apparently does not indicate actual weakness and loss of efficiency on the part of the nerve centers; the test for true fatigue is the quantity and quality of the work done. (4) The work recently done by Joteyko (in *Comptes Rendus Soc. de Biol.*, 1899, 384) bears out Dr. Woodworth's contention apparently. This researcher separated central from peripheral muscular fatigue by interposing a galvanic or ether 'block' in the course of the motor nerve and then subjected the center to prolonged stimulation. The block being then removed, the muscle was immediately innervated, showing that the center had not been exhausted by its exertion.

"The conclusion from all these tests is that the nerve centers—both those of the spinal cord and those of the brain hitherto examined—so far from being quickly burned out or paralyzed by their own activity, are exceedingly resistant to fatigue. They are, in normal conditions, capable of a large amount of work without suffering loss of power."

Now it seems obvious that there is in this brief consideration of the endurance-capacity of nerve cells, in the first place, a confusion of terms, and secondly a disregard of certain psychophysical considerations which change the aspect of the apparent results of the experiments, and so forth, cited.

It is highly probable that what is commonly known as fatigue Dr. Woodworth discriminates as 'the feelings of fatigue,' and that what he calls 'fatigue' (meaning thereby organic, cytologic 'fatigue') would be technically and accurately known as exhaustion. This confusion of common usage with precise scientific meaning has happened frequently—as indeed Professor Lee pointed out in a recent

meeting of the American Psychological Association. This seems an instance where harmful confusion might arise from this misusage. The nerve-cells have strictly of course no fatigue in themselves, for they have no feelings of any sort, but they do become exhausted progressively, however slowly, in cases where their blood supply is ample and their vigor normal. Still, it seems good physiology to suppose that when any particular functional group of motor cells has performed a certain muscular innervation the habitual number of times, there should develop in them a distinct strain, and that this strain of acute falling energy should be, perhaps by cortical radiation, transmitted to consciousness as a distinct and acute unpleasantness, merging often when the work done has been excessive into a paralyzing pain. Such indeed seems to have been the case in fatigue studies like those of Mosso.

It is, then, the individual who experiences the fatigue, and as good examples one may cite the subjects in Mosso's famous experiments and in those of all others who have made these fatigue curves since he made them first. These felt fatigue proper, and their organisms reacted to it in the normal, psychophysiological way. Dr. Woodworth's experiments, on the other hand, are purely physiological, for he expressly disregards the psychic side of the experience, as if it were unconcerned with the question.

It is common knowledge that nerve-cells are in exceedingly close and quick sympathy with their supply of energy, the blood and lymph, and they, therefore, only after long periods of exercise get behindhand in their balance of energy and so become exhausted, in the normally vigorous individual. In the anæmic or the neurasthenic person all recognize that the case is far otherwise.

In the long series of endurance movements described by Dr. Woodworth the psychophysical conditions are probably more complex than apparently is presumed in the present contention of the author. It is the common experience of the subjects in these experiments, *e. g.*, of the present writer, that true fatigue of the neuro-muscular mechanism involved comes on comparatively soon (in fact, just as Mosso's curves indicate that it comes on), and one is impelled spontaneously then, as Dr. Woodworth says, almost 'reflexly,' to rest the weary limb. This feeling, this fatigue, is a protective concomitant of the customary limit of this particular activity. The author describes it thus: "It is, in fact, a very complex affair. It is compounded largely of fatigue sensations from the eyes, neck and other parts of the body that are under strain, of feelings of ennui, of impulses to do something else,

and of the habit of stopping work after a certain time." Now this feeling comes on early and shows itself regularly, if one is not mistaken, in the curves as a more or less distinct period of inaccuracy and more or less incoördination. *Can it be doubted that this arises chiefly in the motor cells involved in the act*, the disturbance there (a temporary acute minor exhaustion) being parallel to pain in the parts concerned? Soon the nerve cells get, so to say, their second wind, and the fatigue passes off or only after a long time becomes altered into the far different, much vaguer but deeper and more persuasive feeling which accompanies exhaustion of the cells concerned, muscular then as well as neural. The feeling of fatigue seems far too acute to be accounted for otherwise than as of central stimulation referred, as usual, to the peripheral part concerned.

Thus the discussion turns, but in an important way, on a matter of terminology, for the present writer is by no means aware that it is held as a common opinion by physiologists, etc., that *exhaustion* of the nerve centers is ever a result of ordinary exercise of any sort. Exhaustion is recognized very generally as a condition of serious import, not easily brought about (save by distinct disease) and only with considerable difficulty overcome. Thus it is not to be doubted that should a voluntary movement for example be repeated for twenty-four hours instead of for one hour or two, the neuro-muscular apparatus concerned would be paralyzed in earnest. This would be true neuro-muscular cell exhaustion, having absolutely nothing to do with fatigue as such. That which is regularly called fatigue, on the other hand, is probably a psychic dissonance from the over-pushed 'voluntary' or the motor cells, coming soon and easily dispelled.

GEORGE V. N. DEARBORN.
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RAPID MEMORIZING, 'WINGING A PART,' AS A LOST FACULTY.

Many years ago I was interested in collecting data on memory and had some correspondence with actors in regard to the former practice of rapidly acquiring or memorizing a part. Among many letters I received one from Mr. Harry Edwards, then connected with Wallack's Theatre, which seems of so much interest that it should be preserved in print. It relates to a faculty which is now no longer cultivated in this period of long theatrical runs. The letter has an additional interest because Mr. Edwards, as an avocation, collected moths and was a man of considerable scientific reputation. The su-

perb collection which he brought together during his tour in different parts of the world is now preserved in the American Museum of Natural History.

HENRY F. OSBORN.

WALLACK'S, NEW YORK, February 23d, '84.

My Dear Sir:

I have been so much occupied with the business of the theatre since I received your note, that I really have not found a moment to answer it until now.

The faculty of "cramming" a part, or, as we call it, 'winging' it, *i. e.*, learning it at the wing, is undoubtedly only to be acquired by practice and long experience, and is in these days of long runs unknown amongst our younger actors. When the bill of the night was changed much more often than is now the case it was a matter of necessity that the words of a part should be quickly acquired, and it was then no uncommon occurrence for a man to take a part in the morning and play it at night, reading it as he came off the stage at every scene and fixing mechanically upon his memory the shape of the written part, the very hand-writing, the position of each speech upon the paper, the sequence of the same, and all details which would present themselves to his physical eye. Thus he would acquire the *words*, not always perhaps the sense, as he would have no time to think about the context; and in some cases if a wrong cue were given it would probably tend to throw the student off the track and upset him altogether. I have known many ludicrous incidents occur as a result of such misadventures. In my early days I had to do a great deal of rapid study and cramming, and soon after I began to play leading business I studied and played six long parts in one week with only two of which I was at all familiar. I once took Sir John Falstaff at twelve o'clock and played the part perfectly at night. This, I think, was the most terrible strain I ever had. I need not say to you that I could not get at the meaning of the character under such circumstances. I also, once, for a wager, studied and repeated perfectly a difficult speech of 17 lines which was read to me slowly 12 times. I give you these as matters of my own personal experience as being those I can myself vouch for. I am sure that nearly all actors of position can tell you much of the same kind. One result of these hurried studies is the words do not remain. They seem to fade from the memory as rapidly as they were acquired. I am quite certain that this process is purely mechanical, and that it is not possessed by all. Men, as a rule, study more quickly than women; in fact I have met very few women who could 'wing' a part. On the other hand I think women are more accurate than men and not so apt to substitute their own words occasionally for those of the author.

If any other points occur to you do not hesitate to write me, and I will help you all I can.

Faithfully yours,

HY. EDWARDS.

Prof. Osborn.

A Correction.

In my discussion in the last issue of the Review, pp. 68–69, I made the mistake, in quoting from Professor Small's article in the *American Journal of Sociology*, of attributing to him the word 'poach,' inadvertently taking it from a private letter from him on the same subject. As soon as I discovered this, I expressed my great regret to Professor Small, and he tells me that he meant nothing by this word beyond what he had said in print in the article referred to. While therefore, as he is kind enough to say, the mistake is 'immaterial,' I myself much regret it, and take this means of publicly saying so.

J. Mark Baldwin.

PSYCHOLOGICAL LITERATURE.

Dictionary of Philosophy and Psychology. Written by many hands and edited by JAMES MARK BALDWIN, with the coöperation and assistance of an International Board of Consulting Editors. The Macmillan Company. Vol. I., pp. xxiv + 644. 8vo. Vols. II. and III. in preparation. $5.00 *net*, per vol.

It is certainly a notable event in the world of science and letters when representative contributors to philosophy, psychology and related sciences, unite in the preparation of a dictionary of the terms employed in the philosophical disciplines. One cannot fail to see in this undertaking a significant phase of the movement towards scientific collaboration which is showing itself as a corrective of specialization in every department of investigation. And it is equally clear that such a collaborated dictionary may be expected to do much towards eliminating the personal element which has always played too large a part in the use of philosophical terminology, and that it will hasten the day when the ideal of universal, objective validity shall be attained for the conclusions and principles of the philosophical sciences. The conception of such a dictionary was indeed timely, and its preparation has put scientific students of all departments, especially students of the departments most intimately involved, under very large obligations.

The complete dictionary is to consist of two large-octavo volumes of definitions and articles, and an additional volume of bibliography. The first volume, with the general introduction and with terms as far as 'Law,' appeared in September of last year. The other volumes are promised to appear soon. The first volume gives an insight into the mode of preparation, and also gives a fair basis for at least a preliminary judgment of the excellence of the whole dictionary. It will, accordingly, be proper to anticipate the later volumes by a general description of the character and scope of the work, and some estimate of the degree in which it has thus far attained the aim which it has set for itself.

The editor invited to his aid a corps of associates and contributors numbering sixty-three in all, and including many of the most eminent scholars in America and England. There were also representative committees of foreign scientists who contributed suggestions and criticisms on French, German, and Italian equivalents, which equiva-

lents, given with each of the terms of the dictionary, constitute one of the important features of the work. The editor has very properly pointed out in his preface that it is entirely justifiable to enforce the decisions of such a body of authorities even when the enforcement of their decision means the sacrifice of personal usages. And certainly students will look eagerly for the decisions of this 'International Committee' on the knotty problems which they have taken up.

With reference to the qualifications of the editor for a work of this kind there can be but one verdict. Professor Baldwin's writings have shown him to be an investigator of high rank, and a contributor to many phases of psychology. The biological sciences on the one side, and the ethical and social sciences on the other, are all treated by him in his works on genetic and social psychology. His broad interests and preparation for the work of editing the dictionary are fully attested by the scope of his contributions to the body of the text. As an original contributor, or as a critical emendator of the contributions of others, his signature appears on the majority of the articles, and his earlier writings are constantly drawn upon as illustrations of standard usage.

The compass of the dictionary may be described by saying, first, that it deals chiefly with subjects belonging to the philosophical sciences and disciplines and with certain closely related topics in neurology and biology. In the second place, such subjects as are discussed, are taken up because of their present-day interest and utility. The historical treatment of philosophy has been largely passed over, except in those cases in which reference to history would contribute to the elucidation of the present use of terms. This attitude towards historical study is emphasized by the editor's prefatory warning to students of Greek and Mediæval philosophy that they will find these subjects only partially treated.

The terms selected for discussion certainly include the terms promised by the principles of selection just described. Serious criticism cannot be directed against the dictionary on the ground of omissions. On the contrary, one cannot help feeling that there has been a too generous departure from the true field of such a work, and an expenditure of valuable energy and space on certain irrevelant terms. Thus, take the following list of articles of somewhat the same general character under the letter A:—Admiralty Jurisdiction, Apprenticeship, Arbitrage, and Arbitration. Or again, consider the fact that a very large number of theological and eccleciastical terms such as Anabaptists, Adiaphoristic Controversy, Atonement, and so on, have been

introduced. It is not that the work on these terms has not been admirably done, for it is of a uniformly high order, but it is a serious question whether it pays to duplicate work on theology, which has recently been very ably and more comprehensively done elsewhere, in a dictionary of present-day philosophical and psychological terminology. And the question rises to the dignity of a criticism of inconsistency of plan when one recalls that mediæval philosophy has been consciously reduced to a minimum.

One department which seems entirely below the level of the rest of the work is the department of biography. This department, in the first place, does not contain the name of any living writer. It is therefore purely an historical record, and as such, contributes very often little or nothing to the main currents of discussion in the book. But even judged by itself as an historical record it must be criticised as very irregular and as very incomplete. Minor names often receive quite as much discussion as those of large importance. The matter furnished under each name is indeed, as the editor remarks in his preface, meager. It might have been made useful even though brief, if it had contained references to sources of fuller information. Furthermore, the list of names selected illustrates in a curious way the capriciousness of the Goddess of Fame. One is tempted to believe that somebody's life of the saints and church fathers must have been very accessible when the selection of immortals was made. Then, too, certain American and English professors of theology who must base their largest claim to a lasting world-wide reputation upon the fact that their names appear here, are given five or six lines in which to record their various pastorates, while Friedrich August Carus, the historian of psychology at the beginning of the last century, and Galileo and Bolingbroke and others go unmentioned.

As to the general articles, many of them are brief, consisting of a definition, a summary of the discussions which center about the term, and a general bibliography. Such short articles may be regarded as dictionary articles proper. Then there are more elaborate articles of an encyclopedic type, some of which treat of terminology, some of which deal with topics considered to be of more general importance. Thus, in this first volume there are several long articles on terminology by Professor Royce, treating of the following special topics: Greek terminology (8 pages), Hegel's terminology (11 pages), Kant's terminology (9½ pages), Latin and scholastic terminology (11 pages). Other encyclopedic articles of notable length are on the subjects: Brain (21 pages), by President C. L. Herrick and Professor C. J.

Herrick; Laboratory and Apparatus (11 pages), chiefly by Professors Warren and Titchener; Hearing (9 pages), by a number of writers; Language (8 pages), by President Wheeler; Beauty and the Beautiful (5 pages), by Professor Tufts; Ethics and Ethical Theories (5 pages), by Professors Sidgwick and Sorley. Other shorter encyclopedic articles of this same general type are present in abundance, but cannot receive individual mention.

These encyclopedic articles make it possible to deal easily with a great many single terms. The terms are defined in their proper places in the longer discussions and are repeated with references to the general article in their proper alphabetical order. This is perhaps the simplest way of solving a difficult problem, but it detracts very much from the utility of the book as a dictionary. The reader who turns to Chronoscope, to take a chance illustration, and finds himself referred to an eleven-page article on Laboratory and Apparatus, will probably feel like suggesting that the eleven-page article be at least interspersed with heavy-faced type indicating the various subtopics which are treated, or that it be indexed at the end as are the articles on terminology. And he will probably fail to see why chronoscope should be classified under laboratory any more than under its own proper initial.

If now we turn to a critical study of the articles themselves, we are impressed with the rich fund of philosophical and scientific knowledge which has here been brought together. Many of the articles are distinct contributions to thought because of the lucidity with which they have arranged the available data bearing on the topic in hand. It is wholly impossible to do individual justice to the many excellent contributions in the dictionary. Indeed, towards many of the articles the present reviewer must frankly take the attitude of a student and express merely a student's appreciation of the comprehensiveness and clearness of their treatment.

Without attempting, then, to give a critical analysis of all parts of the work, the remainder of this review will be devoted especially to the psychology of the dictionary.

Many of the articles on Psychology are written by the editor and Professor Stout, the two contributors often working together. Professor Jastrow has contributed the larger part of the matter on abnormal psychology. Professors Titchener, Warren, Cattell and Sanford, and Mrs. Franklin have written on experimental subjects; and one or two other writers are occasionally called upon.

One is disappointed that there has been so little coöperation among these contributors. They have worked for the most part singly or at

most in twos. It is almost humorous to see the whole company brought out together just once, and their opinions carefully chronicled as to whether the term 'clang' shall or shall not be used, while there are a great many other recommendations of sufficient importance, one would think, to require joint consideration if authority is to stand for anything, which recommendations have very limited support, at least in the number of those who appear as sponsors. Thus, for example, a whole series of terms for volition is suggested under the term action, which series is (to say nothing of its incompatibility with the scheme of German equivalents under the term conation) of doubtful utility. 'Involuntary,' as defined under action and in a later independent article, is certainly a radical departure from the best present usage. One cannot refrain from asking in such a case, where were the other councilors? Or take such terms as Affect, Affection, Colligation and Idea, under which recommendations are made in direct criticism of recognized usages. Such recommendations should be sanctioned by sufficient authority to raise them above the level of mere polemic, or else they should be omitted. It is to be recognized, of course, that this lack of coöperation does not detract from the excellence of the content of many of the articles. But the only way in which the work can be brought at all points to a uniform level is through patient joint consideration.

It is interesting to raise the question whether the individual factor has been successfully eliminated from the various discussions in the absence of the complete joint criticism which would seem to have been desirable. And the answer will differ for the different topics. Thus, 'depth' and 'fatigue' furnish perhaps as good illustrations as any, of topics which have received impersonal consideration. But these were fairly impersonal from the outset. Articles on 'Laura Bridgman' and on 'Illusions of Motion' are encyclopedic articles, and would seem to indicate that the interest of author and editor in these special topics had overbalanced the dictionary idea and allowed a greater latitude. But more important than personal decisions on matters of scope are certain other inconsistencies and limitations in use and definition which make it impossible for one to accept as absolutely final and universal the recommendations of the individual writers.

A striking case of this latter type will be brought out if one investigates the very fundamental question, what does the dictionary have to say on the nature of the elements of consciousness? An element of consciousness is defined as 'any content of consciousness in which introspection fails to detect internal complexity.' We are warned,

however, that "this use of element is opposed to that which applies the term to the original mental functions from the point of view of psychological analysis. The element is such for psychical or mental analysis." No enumeration or illustration of what are currently accepted as elements of consciousness is here undertaken. There are, however, two references relating to the negative part of the definition so that we may, by looking up 'psychological analysis' and 'classification of functions,' find out what are not, according to the dictionary, properly to be designated as elements of consciousness. And there is one reference on the positive side to 'psychical analysis.'

Taking up the negative references, we find under psychological analysis the following: "Analysis * * * in psychology consists in the reduction of complex states of mind to the simpler elements or factors which compose them." Evidently there is confusion ahead when we are forbidden in one article to use 'elements of consciousness' for the results of psychological analysis and are in another article furnished with another kind of 'elements or factors' as the result of such analysis. But let us continue with the negative definition of elements of consciousness. Under 'classification of mental functions' we find the following mentioned as being regarded by various writers as 'ultimate functions': 'intellection,' 'conation,' 'cognition,' 'feeling,' 'will' as a synonym of conation, 'affective consciousness' as an explanatory synonym for feeling, and finally Brentano's 'judgment or belief.' The special term 'classification' under which these are mentioned is defined as 'Distinction of the fundamental constituents of every concrete state of consciousness.' These 'fundamental constituents' or 'ultimate mental functions' are, it must be remembered, not included in the definition of 'elements of consciousness,' for that definition clearly opposed itself to the use which applied the term element of consciousness to the 'original mental functions from the point of view of psychological analysis.'

Turn now to Conation and one finds it defined as 'the theoretical active element of consciousness, showing itself in tendencies, impulses, desires, and acts of volition.' To say nothing of the difficulty of supporting this as a generally acceptable definition of conation, we have still the difficulty, from which even the adjective theoretical does not save us, of squaring this usage with the definition given under 'element of consciousness.'

Or turn to 'affection' and we find that it is 'the hypothetical elementary form of feeling.' Or again, under feeling, we have the recommendation "(1) that Feeling be used for this phase of experience

in its combination, with knowledge and will, in a concrete state of mind, *i. e.*, as a consciously made abstraction from a richer whole; (2) that Affective be employed as synonymous with feeling used adjectively; and (3) that Affection be used for the purely hypothetical element which underlies the concrete manifestations of feeling." Or to use the phraseology of a few lines earlier "the noun affection is applied to the abstraction itself considered as a hypothetical element in the mental life."

Finally, cognition is 'the being aware of an object' and "as above defined, cognition is an ultimate mode of consciousness coordinate with conation and affection."

This lengthy study of the teachings of the dictionary on at least one fundamental question justifies two conclusions. The first is that it is exceedingly difficult to give general definitions of certain widely used terms such as 'element of consciousness'; and the secondis that one's own personal psychology, whether it be in favor of the threefold classification or some other classification, will ultimately determine the way in which he will use terms and define them, and will probably appear sooner or later in strong categorical definitions. It may be that the present reviewer fails to comprehend the insurmountable difficulties in the way of greater coöperation and wider criticism from the whole body of consulting psychologists, but it would seem natural to suggest that greater breadth could have been given to some of the definitions by finding out, first, what is not accepted as universally valid, and then by elaborating at these particular points until the definitions were sufficiently comprehensive to cover at least all the usages in the dictionary itself. As they stand 'element of consciousness' and 'conation,' at least, would hardly be acceptable to such writers as Wundt, Münsterberg, Külpe, Titchener and others, even if we overlook the internal difficulties in the dictionary itself.

The desire to see greater elaboration of some of the psychological articles becomes still more pronounced when one turns to the long treatise on 'Brain,' or to the lengthy discussion of 'Galton's Law,' or to some of the other articles such as the one on 'Laboratory and Apparatus,' which really involve no serious difficulties of terminology. The articles mentioned are excellent in themselves, but they seem somewhat too comprehensive to fit into the general plan.

But criticism must not be wholly, or even in the main adverse. The editor has anticipated some objections to the way in which the work has been carried out and has reminded the critic that "he is one, we are many." And certainly it would be an egregious fault of

criticism to magnify the objections to the extent of overshadowing the virtues. Universal and final no dictionary can be. With a great body of writers contributing to psychology, and some of the best of them 'erratic,' as the dictionary puts it, in the use of their terminology, it is certainly a great service to science that a beginning should have been made in the preparation of concise definitions. The dictionary will undoubtedly give rise to many discussions, but these discussions will be more careful in the matter of terminology than such discussions have ever been before. Translators who have struggled alone with the problem of finding English equivalents, or foreign writers who have been at a loss to understand some of our terms, will also be very greatly aided by the equivalents in four languages which the dictionary has selected so carefully and so satisfactorily in most cases.

The second volume will be awaited with great interest by those who have studied the first. It is surprising to find how many important psychological terms belong under the last fifteen letters of the alphabet. One is constantly reminded that he has only the first half of a comprehensive work in his hands by the cross references which so often carry him to the second volume. The editor and his associates undertook a large task in the preparation of this work. Their results are certainly quite in keeping with the comprehensiveness and the boldness of the undertaking.

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An Introduction to Psychology. MARY WHITON CALKINS, Professor of Philosophy and Psychology in Wellesley College. New York, The Macmillan Company. 1901. Pp. xv + 511. With Bibliography and Index.

A few words will suffice to make plain the general plan of this book. The work is divided into two parts and an appendix. Book I. comprehends a treatment of the normal human mind and its laws; it is complete in itself, and to its scope the discussion of mind has commonly been limited in contemporary manuals. Book II., virtually an appendix to the first, is concerned with two subsidiary topics, the nature of mental activity in simpler forms of life (Part I.: 'Comparative Psychology') in which the processes of brutes and children are discussed; and the description of transient and permanent disturbances of mental function in the human being (Part II.: 'Abnormal Psychology'). The main body of the work is divided into two parts, in the first of which the structural elements of consciousness are ana-

lyzed, while in the second the concrete mental state is considered with especial reference to its significance as a personal attitude. Upon the importance of this methodological division the author lays stress. The contents of the first part will be readily surmised in so far as the nature of such elements is matter of common agreement. An enumeration of the special sense elements is followed by a description of those connected with internal excitation and the consciousness of motion. The question of primitive extensity as an elemental consciousness is next taken up, and upon that succeeds the discussion of a variety of factors which are not uniformly regarded as elementary. These are the attributives: the affections and feelings (why 'feelings' and not *feeling?*) of realness, and the consciousness of relation. It will perhaps somewhat surprise the reader, after learning the method of division upon which the book proceeds, to find that the discussion of Attention brings this first part to a close, instead of introducing the consideration of concrete consciousness experiences. In the second part there is taken up a variety of processes, commonly treated as separable formal functions, in the following order: Fusion and Association, Perception, Imagination, Generalization, Judgment and Recognition; next a group of topics which by common consent are representative of concrete experience, namely emotional moods, with attitudes of will and faith; and finally the typical personal relations and the social and religious consciousness. The book concludes with a *résumé* of important historical concepts in the domain of psychological inquiry.

If there were need to disarm criticism, the writer of this book has made a valid plea in her prefatory statement that it is the embodiment of a course of lectures given to the elementary class in psychology at Wellesley College and is printed primarily for their convenience. Every such work, nevertheless, is inevitably more than a local handbook. It appeals to the practical needs of the whole body of professional teachers, to the theoretical interests of the psychological student, and to a rapidly increasing body of readers whose interest is human rather than technical, who are interested in the problems of psychology as they are in the discoveries of science, in historical research and in literary expression. The excellences looked for in such a work vary with these types of interest, and their comments are not necessarily consonant.

The prime intention of the writer is to produce a satisfactory college text-book. Such a work calls for lucidity of treatment, at large no less than in detail, accuracy of statement, and readableness. In

these regards the present book is one of high merit. It gives a distinct impression of form; no part is unduly expanded, as might readily be done either on account of the richness of illustrative literature which has accumulated unevenly about special topics, or in consequence of personal interest in particular problems. Throughout the book one feels the unity of the whole method of treatment. Points of historical value or importance in connection with the advance of scientific method, but which are of minor rank as aspects of significant human activity, are distinctly subordinated, or treated in an appendix.

The two other points may be mentioned together. The author's treatment of visual sensation will illustrate both aspects in a single instance. The skill with which the details of an intricate subject-matter are here subordinated to a clear exposition of important facts seems to me to be characteristic of the whole work, and I know not any part of it where the student may reasonably fail to follow the thought of the writer. These points are of especial importance to those readers whose study is not assisted by explanatory lectures, and they will appreciate the rare skill with which the author has translated abstract terms and concepts into concrete images, and brought the formal discussion of mental functions into touch at every point with the literary expression of experience.

Matters of personal acceptance or dissent on the part of the reviewer in regard to questions of classification and method are of secondary interest to those general characters of excellence of arrangement and exposition which appeal to every reader regardless of his relation to the theoretical positions assumed by the writer. Points of especial importance, however, may be named in the discussion of the physiological bases of affective qualities, of the forms of association, of the range of structural elements of consciousness, and of judgment and reasoning. Points of interest in relation to the personal standpoint of the writer are presented in the discussion of sensational extensity, the differentiation of perception and imagination upon the basis of immediate social reference, the non-sensational feelings, and the methodological division of the subject-matter into facts and attitudes. Points of more or less important dissent on the part of the reviewer appear in the numerical analysis of sense qualities, especially in reference to the terms of colorless light and of temperature sensations, in the theory of mixed emotions, in regard to the immediacy of the social reference in perception, and in the justification of the separate treatment of concrete personal experience in a scientific text-book.

The book is enriched by a well-chosen and sufficiently comprehen-

sive bibliography. The value of such a literary index to the student beginning his study lies in the definiteness with which he is directed to sources of information in regard to particular points. To be of the highest service the compiler must do the sifting quantitatively as well as qualitatively, and the present list is to be commended for the care which has been shown in the indication of literary sources under each topic considered in the book. The index with which the work is furnished is a topical one instead of being, as many subject-indexes are, exasperatingly verbal in its references. The book is illustrated with thirty-two tables and diagrams and thirteen figures in the text. The publishers are to be complimented on a handsome piece of book-making.

ROBERT MACDOUGALL.

Phaenomenologie des Wollens. By DR. ALEXANDER PFAENDER. Leipzig, Johann Ambrosius Barth. 1900. Pp. 132. Crowned with the Frohschammer Prize by the Philosophical Faculty of the University of Munich in December, 1899.

In the monograph before us the author says he will be scientific, beginning with facts and proceeding to common notions and laws. His method is strictly psychological, retrospective rather than introspective. He does not try to show the causal basis in which the will is grounded, but rather to take to pieces the actual facts of the consciousness of willing. A wider and a narrower use of the word will is made, viz., as effort in general (Streben), and as volition. The latter being a special form of the former, the end of volition is always an object of effort, but an object of effort is not always a voluntary aim. The idea of some experience toward which an attitude of longing, based on appetite, is felt is the essential part of effort. This feeling of longing or tendency-toward is elementary and irreducible, but it is like pleasantness and unpleasantness in its subjective character, all three being modifications of self-feeling (des Ichgefühls). This particular elementary feeling is called, throughout the work, the feeling of effort or effort-feeling. What are the marks of the thing striven for, and how does it come that effort-feeling is joined to this one of all the ideas that enter into the mind?

This is the problem of the relation of the ego to the objective content of consciousness. Upon this relation of the total content of consciousness to a single ego depends the unity of consciousness. Different elements differ in the closeness of their relation to the ego; one is spoken of as clearer, stronger, more vivid, as attended to, etc., to distinguish it from less prominent elements. We should distinguish be-

tween the activity called attention and the consciousness of the activity; the latter consists in effort-feeling, but the more the desire to attend succeeds and the closer the relation of the ego to its content becomes, the more the effort-feeling vanishes. "The relation of self-consciousness to an objective content consists in a unity of ego and content which cannot be further defined" (19). This relation of attention can fluctuate in the degree of its closeness; the extent of that attended to may be larger or smaller; one may attend to a whole as a whole or as a combination of parts; and the part attended to may be now one and now another. In the consciousness of willing or effort the idea of something striven for is present, but the idea (as we think of it) is only the representative of that which is striven for, not the thing itself. The idea is the object of attention; the thing, the object of effort, toward this we experience the feeling of effort. But now the question arises, in what does this intention, or direction toward something not present but represented by an idea, consist?

Popularly it is thought that the idea of an end is an idea filled with pleasure, but this is really not the same as being an object of effort. The idea of pleasure need not be present at all, and it is idle to say that some idea of pleasure is the unconscious end of volition; or, that as a result of habit the pleasure that was once the end-aim has dropped out of notice and the means to its realization become the only end of which we are conscious; or that what is sought is always relatively less unpleasantness or more pleasantness. The important thing is the *present*, and not the represented, pleasure-pain effect of the represented experience, the relatively pleasant feeling which the represented end awakens at the present moment. The feeling of relative pleasure does not arise through a conscious comparison of present feelings, for this is impossible, but it is an increasing pleasantness or decreasing unpleasantness or transition from unpleasantness to pleasantness with the anticipation of the desired experience (57).

Wherein does the feeling of effort consist? Not in a feeling of relatively greater pleasantness or relatively less unpleasantness. All of these may be present in consciousness together—relative pain, relative pleasure, and effort-feeling. The feeling of effort is the immediate experience which gives to the conception of effort in general its specific meaning, and this feeling is a qualitative or attributive element in the consciousness of self.

Positive and negative effort may be regarded as two modifications of the feeling of effort. In positive effort the ego feels itself one with the object of its effort, and in negative, as different from its object.

In the same way, in pleasure we feel one with the object of the pleasure, and in unpleasant experiences we feel different from the object of the unpleasantness. Hence the general feeling of effort may become an effort for something by the addition of pleasure, and a struggle against something by the addition of pain or unpleasantness. The former, however, is accompanied by an increase in the exclusiveness and inwardness of the struggle-tinged attitude of regard, and the latter is accompanied by a decrease in these feelings. There are instances where the idea of the existence of an object of effort, in comparison with the idea of its non-existence, gives pain, but this is where the chosen end is the less of two evils.

The object of positive effort may be either the represented event itself, one's own part in the realization of the event, or the heightening of the worth of one's own person. When one chooses the unpleasant alternative, it is not this which constitutes the true object of his endeavor, but the exaltation of his own personal worth; and this idea gives him a present pleasure. One may strive to possess capabilities upon which he lays no great stress, because they are highly prized by others and because one may exalt his own worth *in the eyes of others* by acquiring them. Under pleasure and pain are thus to be included every sort of satisfaction and dissatisfaction. Understanding the terms in this broad sense, we may say there is no instance of striving for the attainment of an object or of striving to prevent the occurrence of an event, in which the anticipation of the end does not color one's effort, in the one case, with pleasure, and in the other, with pain; and this is true even when the anticipated end involves an anticipation of pain. The author inclines to the view that this addition of pleasure or pain to the feeling of effort makes the latter, in the one case, effort-toward, and in the other, effort-away-from. To decide the matter we should see whether the antithesis of for-and-against does not occur in other psychic functions, as (*e. g.*) in theoretic affirmation and denial, and whether it occurs there with or without relative pleasure and displeasure at increasing inwardness of view.

In the second part of the work the author treats as a special form of effort, volition, the first question being what modification of effort constitutes volition? At the close of this part the results are gathered together as follows. In order that we may have volition in the proper sense of the word, "there must be added to the fact of effort (1) a belief in the possibility of realizing the object through one's own actions; (2) the feeling of effort, which thereby acquires the character of power, must extend itself so as to cover the conditions of the

realization of the object (the effort must become an effort for the realization of the object); (3) in this extension so as to cover both the conditions and the consequences, the effort-feeling must retain the characteristic of (relative) freedom (the effort toward the end must remain victorious), and (4) the feeling of effort must retain or acquire the characteristic of a predominating spontaneity: then and then only will the effort have become a volition in the proper sense of the word (131, 132). A feeling of positive effort possessing the marks of power, freedom and spontaneity are the essentials of volition, and the feeling of power must relate both to the end of volition and to the means to its realization."

We may now will a future action or event, or we may will that a certain action or event now take place; and in the former case any interval of time less than a life may elapse between the volition and its fulfillment. In neither case can the end of effort be its cause, because the end of effort does not exist before the effort has taken place. Motives are causes of effort, although not all such causes enter into motives. Every impulse and effort has a cause, but not every one has a motive. Motive cannot be identified with the end-aim of volition; motive is the whence and end-aim, the whither, of volition. A motive is not the end striven for, but the representation of this end, together with the impulse or tendency toward it. Motives are not something outside the ego, and determination by a motive is self-determination.

It really means nothing to inquire after the motive of any action which is not the means to the realization of some end-aim. Striving for an end-aim is the motive for the effort to realize the conditions upon which the realization of the end-aim depends; but the total fact of volition is itself not motived. "All proper volition stands outside of motivation, is for consciousness something final and, in this sense, free. It is not denied that every volition has its psychological causes; only, one must not call these causes motives." The question as to the motives of volition always refers to the volition of deduced ends which are related to an end-aim as means.

This discussion is written from a psychological point of view, the method consisting largely in retrospective analysis and definition; and, within the limits of this task and the necessary limitations of brevity, it has been admirably done, or so, at least, it seemed to the reviewer. Among points of excellence possessed by the discussion clearness is very prominent. The distinction between the present pleasure of the representative idea and the expected pleasure or gain of

the end striven for is consistently maintained. The thought that the psychological value of an end depends upon the closeness of the relation felt between the ego and the end, a relation involving a significant social reference, is a very important one. The discussion might have gained somewhat had the difference between volition, as an objective phenomenon, and willing or self-determination been introduced.

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ETHICS AND RELIGION.

La Morale ancienne et la Morale moderne. V. BROCHARD. Revue Philosophique, January, 1901, pp. 1–12.

M. Brochard's thesis is that noteworthy differences of conception in historical systems may well help us in properly grasping and attacking difficult problems. As instances of such differences he points out that the Greeks and Romans conceived of God as limited and as pure or passive intelligence, while modern philosophers conceive of him as infinite and as omnipotent will; that, while the ancients thought of matter as different from body, the latter requiring form as well as matter for its full specification, in modern thought matter is identified with body; and again that, while matter is the vague, the indefinite, the unspecified to the Greeks and Romans, to us matter is, if not identical with extension, as Descartes taught, at least, essentially extended and figured.

But the chief differences M. Brochard points out and discusses are those distinguishing the moral conceptions of the ancients from our own. Ancient philosophers had no conceptions of, they even had no words for, duty, moral imperative, conscience, sin, responsibility, or moral liberty, which find so important a place in our moral systems, often lying at their foundation, and though the conception of immortality was familiar to them, it had for them no ethical import.

To be sure duty, and the moral conceptions allied to it, were present in the religious thought of the Greeks and Romans, and even of earlier peoples. But they remained religious conceptions, and no account was taken of them by ethical philosophers. As a religious phenomenon morality was essentially a matter of duty, as an ethical phenomenon it was essentially a matter of conduct profitable to the individual. To us, on the other hand, both the problem of duty and the problem of self-interest are ethical problems.

On this basis, M. Brochard makes the suggestion, very tentatively, that the ancients may have been nearer right than we. He would not

be surprised if the confusion in our ethics, and the failure to establish the science on a positive foundation, were due to the futile attempt to combine two inconsistent points of view.

In support of his position he might have cited the difficulty experienced by Butler, by Sidgwick and Utilitarians generally, and even by Kant, in reconciling duty and self-interest.

But in criticism of his suggestion it should be urged that obligation and the rest are facts, and basal facts, of the moral life, that their relation to religion is quite as much one of support as one of derivation, and that they are products and constituents of the social consciousness as a whole, which includes the religious consciousness, but includes much more besides.

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Les principes de la morale; La loi morale. Ch. Dunan. Revue Philosophique, June, 1901, pp. 594–624.

This is one of a series of three articles in the *Revue* under the same caption, dealing respectively with the highest good, conscience and the moral law. The three are, moreover, extracts from the author's forthcoming book, 'La Morale,' which is to form the third part of his 'Essais de Philosophie générale,' the two earlier parts of which dealt respectively with psychology, empirical and rational, and with metaphysics.

Naturally, conceptions and points of view whose elucidation must be sought elsewhere, appear in this article. But, on the other hand, the author's views have a cosmic sweep that is satisfying, they are articulated into a unitary whole under a watchful eye, and their exposition gives opportunity for the exercise of the high order of keenness and dialectical skill which readers of M. Dunan's earlier writings have come to expect of him. To be sure, his treatment is somewhat abstract, and his dialectics at times border close upon, if they do not verge into sophistry, but the general soundness of his conclusions and the free use of the facts of biology and of the history of ethical theory remove all grounds of serious quarrel. M. Dunan's ethical system seems to be a synthesis of Kant, Spencer and the Stoics unified by his metaphysic.

In the first article morality is said to consist, as the Stoic formula runs, in 'life in accord with oneself and with universal nature,' and that, too, is declared to constitute the *summum bonum* for each man. In the second article the author argues that, just as what he calls the vital instinct sees to the preservation of life in sub-human beings, so

does conscience see to the preservation of man's life as such, *i. e.*, as a self-conscious, rational and self-controlled life; a position that, allowing for pathological cases, is no doubt sound enough although little evidence is given in its support, but always with the proviso that different consciences preserve very different degrees of rationality and self-control, some consciences being all but truncated into blind impulsions, whose support of rationality is wholly unconscious and very imperfect. The rational life preserved by conscience is thought to be a life of self-accord as well, inasmuch as it is irrational to disregard the claims of any vital function, and of accord with universal nature, because, without at least a minimum of accord with the whole of things, self-accord and rationality could not be maintained.

Coming to the third article, which is the special object of this notice, M. Dunan maintains that the law of duty is in fact a categorical imperative; that it is rightly categorical, because duty is rationality in man commanding reasonableness of conduct, and for such a command no further reason could be given without disloyalty to rationality as the supreme end; and that it must be categorical, because living beings, according to his metaphysics the only beings that exist, are necessary beings, since non-being is contradictory, and therefore must will the necessary condition of life and being—which in the case of man is conduct that follows the law of duty—and will it categorically. As to the first statement, it seems to be true as long as conscience is a blind intuition, and even when it reaches the Stoic, Kantian, or Puritan stage that prescribes rigid and abstract laws of duty. But when conscience develops into a fully rational faculty, that is judicially considerate of all pertinent interests, its commands are not infrequently halting, checked by the 'if' of modest ignorance. The second statement would seem to be justified for the reason given, and because in so far as conscience champions fully rational conduct, its self-sufficiency is not arbitrary, since conduct is rational only in so far as it considers *all* pertinent conditions, and to that extent there are none left to condition it. But the third argument seems more than doubtful. Even granting the metaphysical position, admitting that being in general is necessary, does it follow that any particular being, *e. g.*, man, exists necessarily? Would it be maintained that the disappearance of the human race would involve a contradiction?

While accepting duty as a categorical imperative with Kant, M. Dunan is anxious to give it a concrete content, and discusses the question at some length. The author's main point is that duty, in commanding the greatest possible active accord with oneself and with

universal nature, in effect commands life at its fullest, richest, and deepest. Moreover, what duty commands is human life, which, as such, is to be in harmony with all other lives, and with the organized totality of living beings that forms the unitary living whole properly to be called God.

Interesting, too, is the author's reconciliation of duty and happiness. Admitting apparently that any definition of morality making it inconsistent with happiness would be mistaken, he goes on to argue that a life in accord with self and with universal nature is the necessary and sufficient condition of happiness, and that, therefore, while happiness is not the supreme end, in seeking the latter happiness is best secured. But the pursuit of pleasure M. Dunan condemns severely. It necessitates the discordant exercise of some few functions to the neglect of others.

For the rest, in opposition to Kant the author maintains that the moral law is not everywhere the same and unchangeable. In agreement with Kant he argues with much subtlety of dialectic that it is a law of autonomy. In further agreement with Kant he holds that the following of genuine good intention insures absolute morality for the agent in each case, with the warning, however, that practices condemned by all civilizations, even the grossest, 'like perjury and assassination, * * * which cannot be admitted by any form of organization of human life,' cannot be approved 'in good faith' by any agent. To Kant's separation out of will, and exclusion from it, of all sentiment and feeling, M. Dunan dissents vigorously and convincingly, emphasizing especially Kant's inconsistency in admitting within good will the sentiment of respect. The article concludes with a discussion of the relation of the author's views to those of the Stoics, Aristotle, Kant and Spinoza.

This brief notice can give but an inadequate idea of the grasp and precision of the author's thought, of the serried closeness of his reasoning, and of his argumentative resourcefulness. To gain such an idea the three articles must be read.

S. E. Mezes.

A Psychological Test of Virtue. By George M. Stratton. International Journal of Ethics, XI., January, 1901. Pp. 200–213.

The subject of this discussion is Professor Dewey's theory of conduct, as represented in his syllabus, 'The Study of Ethics.' In Professor Dewey's view action in its earlier stages is impul-

sive, the impression of the moment calling forth an immediate response; in the later stages (represented in relatively reflective human action) the simple impulse has to deal with competing impulses, and action is the result of their interplay. The characteristic of the more developed person, then, is that each of his acts is participated in by a wider variety of activities. As such it shows the various sides of his character, the hasty, superficial, impulsive reaction telling of but a single side. In this Professor Dewey discovers the basis for determining the moral value of what we do; an act is morally good in so far as it represents a perfect coördination of all sides of our character; so far as it represents only one side of our character it is wrong. Now what our author criticises is not Professor Dewey's doctrine itself but its claims to represent the standpoint of psychology. In Professor Dewey's view the real man is represented only in a perfect coördination of all his impulses; but for psychology all the activities of the man, many-sided or one-sided, mutually consistent or inconsistent, are equally expressive of his real nature. Professor Dewey's standpoint is, accordingly, the standpoint not of psychology, but of the metaphysical doctrine of absolute idealism. As a result of this standpoint he ignores the difficulties of the ethical problem. Assuming that the direction of coördination is somehow exhibited in the empirical character of the impulses themselves he fails to state in concrete terms how the ideal coördination is to be effected or in what it consists. Accordingly, he fails to show the connection between the real self, represented in perfect coördination, and the imperfect self, represented in the empirical conflict of impulses. Thus, by leaving evil actions essentially unconnected with the real person, he takes away all moral responsibility for such conduct.

WARNER FITE.

L'évolutionnisme en morale, étude sur la philosophie de Herbert Spencer. JEAN HALLEUX. Paris, Felix Alcan. 1901 Pp. 228.

As announced in his title the author takes Herbert Spencer as his type of evolutionary moralist. His treatment of evolutionary ethics reduces itself, therefore, to an analysis and criticism of the evolutionary hedonism presented in the 'Data of Ethics.' His analysis of the Spencerian theory, which occupies the first part of the book, is reasonably clear and objective. His criticism proceeds apparently from the standpoint of the Catholic theology and does no more than repeat the argument with which the evolutionary conception was greeted at its

first announcement by theologians generally. He holds that human life cannot be conceived as a further development of animal life; and that the course of history does not point to the future condition of universal human happiness which hedonism expects. Mr. Spencer's system fails, moreover, as an ethical theory, to satisfy our moral consciousness and to explain our sense of duty. And, finally, from a practical standpoint, it offers no sufficient motive for moral effort. The author makes no attempt toward a systematic formulation of his own view, but from occasional remarks it appears that his philosophical system (which is also a system of theology) is practically identical with the idealistic view known in ethics as the theory of self-realization.

WARNER FITE.

UNIVERSITY OF CHICAGO.

Les Maladies du Sentiment Religieux. E. MURISIER, Professeur à la Faculté des Lettres de l'Académie de Neuchâtel. Paris, Félix Alcan. 1901. Pp. 175.

This is not a clinical study of religious maladies, but an essay on the nature of religion. It is based, however, upon analysis of certain religious abnormalities under the theory that, just as the progress of dementia reveals the nature of the mind by destroying its functions one after another in the inverse order of their evolution, so the self-destruction of religion in its extreme forms may be made to reveal the essential nature of the religious impulse. Two such extreme forms, ecstasy and fanaticism, occupy substantially the whole of the author's attention. These are studied almost altogether at second hand, that is, through biographical and historical literature.

The main thought of the essay is the reduction of the contemplative and active types of religion respectively to egoistic and social impulses and the exhibition of the inner unity of the two. The contemplative type, beginning in an unsocial withdrawal from the world, culminates in ecstasy, which tends to the dissolution of the individual consciousness, while the active type leads to a fanatical effort after social uniformity and ends by destroying its own goal. The nature of religion is shown in both types, but more clearly in the mystical or contemplative life. Here three stages of the progressive dissolution are noted: First, social relations are lost from consciousness; then intellect ceases to function, and there is left, finally, the characteristic affective state of the ecstatic with its tendency to unconsciousness. From this the inference is drawn that the affective element in religion reveals the true character and the primordial rôle of the religious im-

pulse. The tranquility of the ecstatic, with its extinction of all difference and antithesis, shows religion to be an effort to unify and systematize an unstable consciousness. The view is apparently taken that religious sentiment has its genesis in organic discomfort. I say 'apparently,' because the method of treatment leaves one in doubt as to where, if at all, the author draws the line between what is normal and what is morbid in religious sentiment. In any case, he holds that the essential fact in religion is the effort to secure, through a higher, directing power, unity and system in an otherwise incoherent manifold of consciousness.

This yields him a clue to the function of religion. Inasmuch as 'personality is not an entity,' but 'results from a coördination of states that are incessantly renewed,' the fact of coördination demands an explanation. Murisier sees in religion "the directive idea of the evolution of personality," not the only idea of its kind, but the earliest and, with the great majority of men, the most efficacious one. In a parallel way, religion performs a function of social coördination, so that unity and system is its goal in both directions. These conclusions, which are based upon a rather narrow range of facts, are more suggestive than conclusive. They offer, at least, a timely contrast to Marshall's reduction of religion to a social instinct that works to the actual disadvantage of the individual.

GEORGE A. COE.

NORTHWESTERN UNIVERSITY.

INHIBITION.

Untersuchungen über psychische Hemmung. G. HEYMANS. Zeitschrift f. Psychol. u. Physiol. d. Sinnesorgane, Bd. 21, Heft 3, and Bd. 26, Heft 5 u. 6 (1899 and 1901). Pp. 321–359, 305–382.

The investigation of no problem could be more timely than of this one of the general laws of inhibition. The title suggests the point of view from which the results of the experiments are interpreted. Doubtless inhibition is always a psychophysical fact and ultimately must be interpreted in psychophysical terms, but it is useful, if only negatively, to have the subject approached from the purely psychical point of view.

By psychical inhibition the author signifies the general fact of the reduction in intensity or the complete obliteration of one conscious content by another. He regards his experiments in the light only of pioneer work in opening up a new field, but intimates that his law of psychical inhibition applies to a much wider range of facts than he is

able to take up in his own researches, which, stated broadly, are a study of the effect of the greater upon the smaller of two stimuli differing either in quality or in intensity and applied simultaneously to the sensory surface.

The phenomena of inhibition are various in character, ranging from the general facts of the limitation of the field of consciousness and the principle of contrast in the affective life to the specific inhibitive aspect of attention and the measurable modifying effect of one stimulus upon another. The inhibiting effect of a greater upon a smaller pain has long been recognized. The inhibiting effect of one sensation or idea upon another is seen in the ticking of the clock which becomes lost in the sound of the piano, or in the student who, absorbed in his studies, forgets an appointment, or in the soldier who in the heat of the battle does not feel the pain of his wounds. If you shut both eyes you have the sensation of black; if then you open one eye the sensation of light of that eye completely inhibits the sensation of black of the other eye. The author also relates the facts disclosed by his studies to the facts of attention and interest—to the general fact that the interesting process, *i. e.*, the process attended to, becomes clearer and more distinct than the rest of consciousness, with the correlative consequence that the processes attended from become less clear and distinct.

The fundamental question in these investigations was the nature of the laws which control the inhibiting effect of one sensation upon another. The measure of this inhibiting effect was the raising of the stimulus threshold. The specific question thus becomes: According to what law does the raising of the stimulus threshold follow the increase in the intensity of the inhibiting stimulus? Experiments were made on color, taste, sound, pressure, and light sensations. Two methods were followed: the application of stimuli of different qualities to the same sensory surface, and the application of qualitatively identical stimuli to different sensory surfaces. Both methods give the result that the weaker are inhibited by the stronger sensations in proportion to the intensity of the latter.

The author devotes considerable space to the discussion of the question whether these inhibiting phenomena are to be interpreted as physiological or as psychological. He concludes, in accordance with his "idealistic monism" (in which the distinction between the psychical and the physical seems to reduce itself to the distinction between central and peripheral processes in the nervous system), that they must be interpreted as psychological. His classification of these phenomena

as exclusively psychical, and especially his apparent identification of the psychical with the cerebral, are, of course, metaphysical interpretations of the data which his useful researches have brought to light. While interesting, yet these generalizations are the least valuable part of his work. They are rather deductions from his (materialistic?) idealism in philosophy than inductions from his scientific experiments in psychology.

He explains the fact of the lack of correspondence of the absolute stimulus threshold and the sensation threshold by his law of inhibition, *i. e.*, by the simultaneous demand made upon the attention by concurrently acting stimuli. He rejects the hypothesis of neural resistance or inertia as being merely theoretical and unsubstantiated by facts. It is certainly an interesting suggestion that the ultimate explanation of the lag of sensation behind stimulus is due to the reciprocally inhibitive effect of concurrently operative stimuli. That is, the stimulus threshold, so-called, simply marks the limit of the eliminable effects of the simultaneously acting stimuli.

According to Heymans, every idea in the widest sense of the term comes to have a certain inhibitory power and resistance which depends for its intensity on different circumstances of emotional tone, etc., and which can be strengthened by the concentration upon it of the voluntary attention. If the intensity and feeling tone of an idea is small, it will have an inhibitory power only if, and in so far as, the attention is directed upon it, but an idea of greater intensity and tone may not need this concentration of the voluntary attention. The important conclusion which he comes to is that instead of sensations increasing in proportion to the logarithm of the stimuli they increase in direct proportion to the stimuli.

That is, Fechner's law is shown to be true only under certain conditions; in fact, to be true only because of the constant reciprocally inhibitory influence of all the contents of consciousness at any given time. Take away such concurrently acting influences and it is no longer true that the sensations increase in proportion to the logarithm of the stimuli, but in direct proportion to the intensity of the stimuli. To be sure, this also is a purely theoretical law which finds no exact illustration in actual experience, but inasmuch as both laws are theoretical in this sense, this limitation on Fechner's law, if true, is certainly an important contribution to the psychology of sensation.

Fechner's law is shown to be, not a necessary deduction from, but an unwarranted interpretation of Weber's law so-called, which is simply a formulation of certain facts. The author quotes Hering's

objection to the Fechnerian hypothesis, and he puts his own in relation to the researches of Merkel and Ament as casting doubt upon the logarithmic interpretation of Weber's law. He sets aside Wundt's principle of the purely relative measure of intensities, and concludes by applying his own law of inhibition, whereby the difference limen becomes regarded as essentially an example of inhibition, and Weber's law as a special limiting case of the same. According to Weber's law the difference sensation is a proportional part of the stimulus. According to Heyman's law the sensation increases in intensity in direct proportion to the increase in intensity of the stimulus. Furthermore, according to his law, in its application to the difference limen, the inhibited sensation is proportional to the intensity of the inhibiting sensation. Hence, in the case where the difference sensation is inhibited, it is proportional to the inhibiting sensation, and therefore to the stimulus (Weber's law), since, according to Heyman's law, the sensation and stimulus are throughout proportional. Thus Weber's law appears simply as a corollary of this fundamental law of inhibition —that weaker sensations are inhibited by stronger sensations to a degree proportional to the intensity of the latter.

H. HEATH BAWDEN.

VASSAR COLLEGE.

FLUCTUATIONS OF THE ATTENTION AND RHYTHM.

Untersuchungen über die sogenannten Aufmerksamkeitsschwankungen. E. WIERSMA. Zeit. f. Psych. u. Phy. d. Sinn., Bd. 26, Hft. 3 u. 4. P. 168.

This is the first of a series of articles that Dr. Wiersma proposes to submit on the problem of the fluctuations of the attention. It considers the course of the fluctuations in normal life with stimuli of different intensities. The second will be devoted to a study of the phenomenon in normal subjects under the influence of bodily and mental strain or under the influence of drugs, and the third to pathological cases.

In this investigation Dr. Wiersma worked first to determine the influence of the intensity of the stimulus upon the course of the wave. He found that with an experimental period of five minutes, the period of rotation of his drum, there was constant increase in the time that the stimulus was imperceptible as he decreased the intensity of his stimulus. For sight the extreme stimuli were related as 1 to 3 and the corresponding times of invisibility were 197.9 to 16.1, and there was a close correspondence in the results for the other senses. Dr.

Wiersma, however, overlooked the fact that Marbe had already worked with this phase of the question with the same result, although the investigation had not been so extensive.

Even more interesting are the effects of practice and fatigue during the time of the experiment. This was brought out by dividing each of the experimental series into three parts and comparing the total times of invisibility for the different portions of the curve. The course of the curve varies for the two subjects. Dr. Wiersma shows the effect of practice in decreasing the time of invisibility at first and only later the effect of fatigue, while Professor Heymans showed the effects of fatigue from the beginning. They also plotted the results of different series in a single sitting. The experiments continued for five minutes and were separated by resting periods of eight minutes. In these curves the results are not consistent, but in general Dr. Wiersma shows the effect of practice throughout the period, while Professor Heymans shows practice first, then fatigue. The results also show a difference between day and night workers that is typical.

The experiments add another bit of evidence for the subjective origin of the attention wave and serve to confirm the conclusion that the course of the attention wave may be used as a measure of the efficiency of the attention or of the tonus of the sensory cortical cells. If Dr. Wiersma had used the ratio between the periods of visibility and invisibility as his measure instead of the total time of invisibility it would be possible to compare the results for experimental series of unequal length.

W. B. PILLSBURY.

UNIVERSITY OF MICHIGAN.

A Genetic Study of Rhythm. C. R. SQUIRE, Ph.D., late scholar in psychology at Cornell University. Amer. Jour. Psych., XII., 492–589. 1901.

Dr. Squire contributes to the discussion of rhythm in two ways. On the genetic side she presents an order of development among rhythmic forms on the basis of ease in speaking them. On the analytical side she criticises Wundt's definition of rhythm as a form of feeling and herself defines rhythm as a perception with certain characteristics.

The method of investigation was to observe children of the first, fourth and seventh grades as to the manner in which they read the syllable 'me' repeated 30 times. These observations were supplemented by a series of records made by three children reading the same syllable into a Rousselot microphone. Temporal, intensive and pitch

differences were recorded both when the subjects grouped freely and when they were directed to read with a trochaic or other accent.

The author finds a tendency to 'primary' rhythm or ungrouped succession first manifested. When grouping begins she believes the spondee is the simplest form, the group being set off solely by longer intervals. The trochee, instead of being the simplest group, comes second in her classification, and then follow the iambus, dactyl, anapæst and amphibrac in order. It is to be noted that her conclusion that the iambus is simpler than the dactyl is not borne out by the record of errors in repeating the different forms, page 534.

To test the subjective effect of change in pitch a modified form of the Sanford apparatus was used. The subject listened to sounds collected by resonators from *a* and *c* electric forks. The author concludes that pitch is not a determinant of rhythm independent of its interpretation as a difference in intensity.

Breathing curves were recorded when the subjects talked into the microphone, but it is doubtful if they show any functional connection between the perception of rhythm and respiration. The use of the lungs in speaking rhythms probably accounts for the effects found. Observations on concomitant movements and the effect of chorus reading are suggestive but not conclusive.

Dr. Squire argues that rhythm is not a state of feeling because it may occur without feeling, does not become blunted by repetition, is not accompanied by the affective curve and has limits and differences in complexity which feeling fails to explain.

J. Burt Miner.

Columbia University.

TOUCH.

Ueber die Flächenempfindung in der Haut. Helen B. Thompson und Katharina Sakijewa. Zeitschrift für Psychologie und Physiologie der Sinnesorgane, December, 1901, XXVII. Pp. 187–199.

This article reports a study of judgments of the size of surfaces touching the skin, and the influence of pressure on these judgments. The experiments have the merit of simplicity, and the observations are interesting and valuable. The apparatus consisted of pieces of cork of different sizes attached to an instrument for measuring the pressure. With these the discriminating power of different parts of the body was investigated. The pressures used were 20, 70, 100, 150, and 250 gm. It was observed that few judgments were purely

judgments of size. The subjects who knew that the pressures of any two surfaces to be compared were always equal were likely to base their judgments on the subjective feeling of difference in pressure. On parts where the tissue beneath the skin is soft it is difficult to tell just what are the chief factors. The smaller surface sinks deeper and this seems to aid in judging. Where the bones are close to the skin the judgment is in the highest degree based on surface sensation. This is probably because the edges are felt more plainly here than on soft tissue. Changes of pressure between 20 and 250 gm. make but little difference so long as the pressures of the two surfaces to be compared remain equal. The discriminating ability of all parts of the skin not trained in touch is about the same.

J. F. MESSENGER.

COLUMBIA UNIVERSITY.

GENETIC.

Experimentelle Untersuchungen über die Gedächtnissentwickelung bei Schulkindern. MARX LOBSIEN. Zeitschr. für Psychologie u. Physiologie d. Sinnesorgane, Band 27, Heft 1. Pp. 34–76.

This investigation shows the manner in which the memory of school children develops from year to year and also the influence of content and sex upon memory. The experiments were made in the Kiel primary school upon 462 children (238 boys, 224 girls) ranging in age from 9–14½ years. The work was suggested by the research of Dr. Netschajeff with the school children of St. Petersburg (*Zeitschrift*, Band 24, Heft 5) and in general followed the same method. A series of nine successive stimuli was given to the children, who were then required to write down as much of the series as they could remember. Eight such series were given to each pupil. Series I. consisted of nine objects—newspaper, key, handkerchief, glass, table, box, book, hand, chalk. Series II. consisted of nine sounds—clapping the hands, knocking, tearing paper, stamping, whistling, ringing a bell, rolling a ball, jingling keys, humming. Series III. was nine spoken numbers—37, 68, 54, 27, 63, 96, 45, 28, 17. Series IV. was nine spoken words connected with visual ideas—Blitzstrahl, Wandkalender, Zifferblatt, Fensterbank, Wandteller, Mondscheibe, Sonnenstrahl, Feuerschein, Himmelsblau. Series V. was nine spoken words connected with auditory ideas—Schutz, Gekreisch, Gebell, Donner, Gebraus, Krachen, Gebrüll, Pfeifen, Geknall. Series VI. was nine spoken words connected with touch images—kalt, weich, rund, glatt, heiss, rauh, spitz, kühl, scharf. Series VII. was nine spoken words connected with the emotions—Sorge, Feigheit, Hoffnung, Zweifel,

Hunger, Angst, Freude, Reue, Neid. Series VIII. was nine spoken words which were meaningless sounds for these children—auditiv, simultan, subjectiv, Transaction, Lyceum, Quantität, Integral, Diffusion, Attraction.

The results of these tests are given in 67 tables and curves. From these the following conclusions are drawn: (*A*) When merely the amount recalled is considered. (1) Memory for each series improves from year to year, but not by constant amounts—Series I., III., V., VI., VII. with both boys and girls show acceleration at 11 and retardation at 12, Series II. shows acceleration for the girls and retardation for the boys at 12, Series IV. shows acceleration for boys and retardation for the girls at 12, Series VIII. shows acceleration for both boys and girls at 12. (2) The girls, with few exceptions, exceed the boys in ability to recall—Series I. and II. show the largest sex difference at 12, the least at 11, Series III., IV., V. and VII. show less sex difference at 12 than at 11, Series VI. and VIII. show little sex difference. (3) Objects and numbers are best recalled by both sexes, words connected with emotions and meaningless words are most difficult to recall. (4) Boys show greatest improvement in Series VII. and least improvement in Series II., girls improved most in Series IV. and least in Series I. (probably because there was so little room for improvement in this series). (*B*) Measured by the exactness with which the order of stimuli in each test is reproduced. (1) There is a general increase in the accuracy of recall, retardation at 10 with subsequent acceleration for both sexes is shown in Series III., IV., V. and VII., retardation at 11 followed by acceleration in both sexes is shown in Series I. and VIII., and in Series II. and VI. the girls show retardation at 10, the boys at 11. (2) Greater accuracy of recall is shown by girls in Series I., II. and V., by the boys in Series VI., VII. and VIII. (3) Objects and numbers are most accurately recalled by both sexes, sounds and meaningless words show least accuracy. (4) Both sexes show greatest improvement in accuracy of recalling objects and numbers, and least improvement in sounds, meaningless words and words connected with the emotions.

The tables and curves contain a number of errors which, however, may be discovered and corrected by careful cross-reference, while a clear resume would add much to the value of the paper.

J. E. Lough.

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COMPARATIVE.

Der Gesang der Vögel, seine anatomischen und biologischen Grundlagen. Dr. Valentin Haecker. Jena, Fischer. 1900. Pp. vi + 102.

After presenting a short discussion of the structure of the vocal apparatus of birds and after paying tribute to the contributions of Darwin, Wallace, Spencer, Weismann, Jaeger and Groos on the subject of bird song, the author proceeds to show that the present dimorphism evidenced in the song of male and female is the result of a differentiation, a division of labor, the original condition having been monomorphic. In this process of differentiation a new instinct was evolved, viz., the coquetry, hesitation or passiveness of the female. In the same way it may be said that on the part of the male a new instinct was evolved, viz., the conduct characteristic of courtship. The unusual activity of the male fulfils at least two functions, heightening by a process of auto-stimulation the individual's own sexual excitement and stimulating reflexly certain activities in the female. As in the so-called social gatherings of the paramecia the active movements of the newcomers are inhibited by the carbonic acid excreted by those already present, so the courtship activities of the male act upon the female, *i. e.*, reflexly. Groos had already spoken of *unconscious choice* in this respect; differential reflex action upon the presence of certain stimuli, following the terminology suggested by Lloyd Morgan and the experimentation of Loeb, seems, however, the better term to use. Granted then that the phenomena of courtship in the bird world are instances of reflex action, it follows that sexual selection may be subordinated to natural selection in so far as there would be a survival of those courtship or sexual reactions which possessed the greater survival value for the species.

The utility or survival value of the many specialized, differentiated forms of bird song is discussed with originality. Certain vocal utterances are useful as companionship or flock notes, aiding these most mobile creatures to a closer union and association, their powers of flight giving rise to a dissociating or disintegrating tendency. Warning notes possess survival value in many ways. Many atavistic characteristics, such as the cackling of the hen as explained by Hudson, could be cited. Certain vocal utterances, like human language, are recognition marks of species, of subdivisions of species and of individuals. Attention is called to the differences in meaning in the varying pitch and tone of the same note. Just as orators and singers use those unusual modulations usually associated with emotional life, so in bird life the use

of certain unusual notes induce definite differential emotional reactions. Signal cries are the bugle calls for the migration advance, other notes are pairing notes in the spring. Many notes and melodies which are useful for certain purposes at one time are used at other times and are thus instances of correlation of function. Haecker thinks that these out-of-season notes may be useful as practice. Similar, recurring, seasonal atmospheric conditions may also release reactions which function normally, say, at the pairing time. Song notes are usually intended for other ears than those of the singer. Many other interesting observations are made, such as the growth of the courtship dance out of the struggle and fight of rivals (Kampf und Tanz lassen sich nicht von einander trennen), etc.

The term song instinct, it may be mentioned, should be modified to song activity, since notes, melodies and rhythms are sometimes acquired.

ARTHUR ALLIN.

UNIVERSITY OF COLORADO.

NEW BOOKS.

The Mental State of Hystericals. PIERRE JANET. With a preface by J. M. CHARCOT. Translated by CAROLINE ROLLIN CORSON. New York and London, G. P. Putnam's Sons. 1901. Pp. xviii + 535.

The Basis of Social Relations. DANIEL G. BRINTON. Edited by LIVINGSTON FARRAND. New York and London, G. P. Putnam's Sons. 1902. Pp. xxi + 204. $1.50.

L'Audition. PIERRE BONNIER. Paris, Octave Doin. 1901. Pp. 275.

Principles of Western Civilization. BENJAMIN KIDD. New York and London, The Macmillan Company. 1902. Pp. 538.

Typical Modern Conceptions of God. JOSEPH ALEXANDER LEIGHTON. London and Bombay, Longmans, Green & Co. 1901. Pp. x + 190.

Mental Growth and Control. NATHAN OPPENHEIM. New York and London, The Macmillan Company. 1902. Pp. ix + 296. $1.00.

Lectures and Essays. WILLIAM KINGDON CLIFFORD. Edited by LESLIE STEPHEN and Sir FREDERICK POLLOCK. London and New York, The Macmillan Company. 1901. Vol. I. Pp. 409. Vol. II. Pp. 342.

Intuitive Suggestion. J. W. THOMAS. London and Bombay, Longmans, Green & Company. 1901. Pp. 160.

Russian Political Institutions. MAXIME KOVALEVSKY. University of Chicago Press. 1902. Pp. 299.

The Study of Religion. MORRIS JASTROW, Jr. London, Walter Scott; New York, imported by Charles Scribner's Sons. 1901. Pp. xiv + 451.

The Evolution of Sex. PATRICK GEDDES and J. ARTHUR THOMSON. London, Walter Scott; New York, imported by Charles Scribner's Sons. 1901.

The Criminal. HAVELOCK ELLIS. London, Walter Scott. 1901. Pp. xix + 419.

NOTES.

MR. W. E. JOHNSON, of King's College, Cambridge, has been appointed to the lectureship in moral science established as a memorial to Professor Sidwick.

M. PIERRE JANET has been appointed to the chair of psychology in the Collège de France, vacant by the retirement of Professor Ribot.

PROFESSOR VON KRAFFT-EBING is about to retire from the chair of psychiatry at Vienna and will be succeeded by Professor W. von Jauregg.

WE regret to record the death of Dr. Robert Adamson, since 1895 professor of logic and rhetoric at Glasgow University, and previously professor of logic and mental philosophy at Owen's College, Manchester.

THE American Philosophical Association will hold its first meeting at Columbia University during Easter week.

PROFESSOR HUGO MÜNSTERBERG, as chairman of the philosophical department of Harvard University, is making special efforts to secure funds for the erection of a building for the department, to be known as Emerson Hall. Plans have been drawn by Mr. A. W. Longfellow, according to which the hall is to be a three-story structure, of red brick. On the first floor there will be small recitation rooms and one large lecture hall, seating 400 students. The rest of the floor will be taken up by a philosophical library, comprising an extensive collection of philosophical works. The second story will contain small recitation rooms and seminary rooms for advanced work. The entire third floor will be used for a psychological laboratory. There will be one large room, where work of a general character may be done. The rest of the laboratory will be divided into fifteen research rooms.